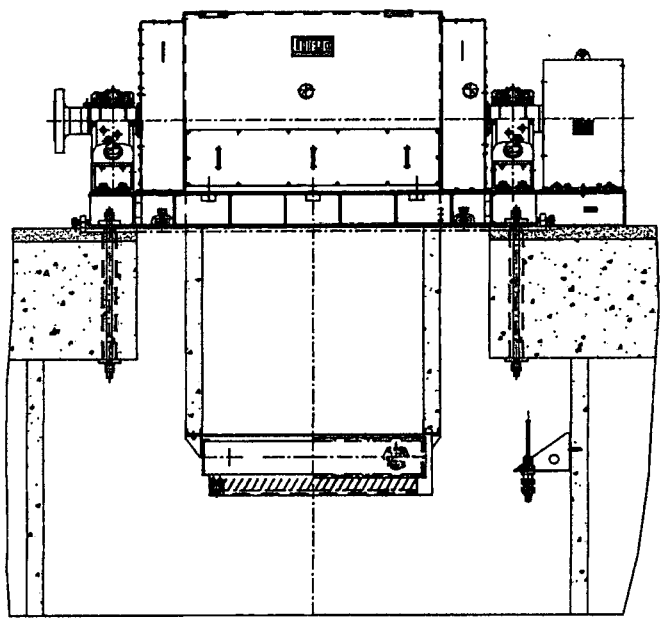
INSTALLATION AND

MAINTENANCE MANUAL

FOR "S" LINE GENERATORS



IMPORTANT: READ CAREFULLY THE INSTRUCTIONS INCLUDED IN THIS MANUAL IN ORDER TO ENSURE A SAFE AND CONTINUOUS OPERATION TO THE EQUIPMENT.

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FOREWORD

The electricity plays an important role on people´s life either supporting them on the achievement of new developments and progress or providing them comfort and entertainment.

The generator is the equipment used to generate such energy through different means such as aeolic, hydraulic, thermal systems and others.

Considering the prominent role the generator plays, it should be regarded as a prime power unit.

This means to say that both its installation and maintenance require special care in order to ensure perfect operation and longer life to the unit.

THE INSTALLATION AND MAINTENANCE MANUAL FOR "S" LINE GENERATORS intends to assist those who deal with electric machines making their tasks easier to preserve an important equipment:

THE GENERATOR!

WEG MÁQUINAS LTDA.

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LINES OF WEG SYNCHRONOUS MACHINES

S T A . 3 1 5 M I 3 1 S 0 4 C	
Type of machine	
G	Standard Synchronous machine
S	**Engineering synchronous machine**
A	Self-regulated generator

S T A . 3 1 5 M I 3 1 S 0 4 C	
Characteristics	
T	Brushless generator c/w auxiliary coil
P	Brushless generator c/w auxiliary exciter
S	Brushless generator w/o auxiliary coil
L	Generator with brushes
D	Generator with brushes
E	Brushless generator w/o auxiliary exciter
F	Brushless generator c/w auxiliary exciter
M	Single phase Brushless generator w/o auxiliary exciter
N	Single phase Brushless generator c/w auxiliary exciter
Q	Single phase Brushless generator c/w auxiliary coil
R	Three phase self-regulated generator
C	Single phase self-regulated generator

STA . 3 1 5M I 3 1 S 0 4 C
Frame length
S, M, L, A, B, C, D, E ,F

STA .315 MI 31S04C	
APPLICATION	
I	Industrial
M	Marine
T	Telecommunications
C	CPD
N	Naval
E	Special
V	Inverter

S T A . 3 1 5 M I 3 1 S 0 4 C	
Cooling Methods	
A	Drip proof self-ventilated
F	Air-air heat exchanger
W	Air-water heat exchanger
I	Independent forced ventilation
D	Self-Ventilated by ducts
T	Forced ventilation by ducts (S Line) or three phase self-regulated (ART)
L	Forced ventilation with air-water heat exchanger
V	Drip proof forced ventilation
M	Single phase self-regulated
K	Enclosed self-ventilated

S T A . 3 1 5 M I 3 1 S 0 4 C
Frame
.112 up to 2.000

S T A . 3 1 5 M I 3 1 S 0 4 C
Lamination core item
O0 up to 99

S T A . 3 1 5 M I 3 1 S 0 4 C	
Type of rotor	
S	Salient poles
L	Flat poles

S T A . 3 1 5 M I 3 1 S 0 4 C
Number of poles

1. INTRODUCTION

IMPORTANTE:
All standards and procedures included in this manual must be followed accordingly to ensure a proper operation to the equipment as well as to ensure safety conditions to the personnel involved in the generator operation. Following these instructions is also important for the warranty as explained at the end of this manual. Therefore, we strongly recommend to read this manual carefully before generator installation and operation. In case of any further doubt, please contact Weg Maquinas Ltda.

2. GENERAL INSTRUCTIONS

2.1. SAFETY INSTRUCTIONS

All personnel involved with electrical installations, either handling, lifting, operation and maintenance, should be well-informed and updated concerning safety standards and principles the govern the work. Before work commences, it is the responsibility of the person in charge to ascertain that these have been duly complied with and alert his personnel of the inherent hazards of the job in hand.
When incorrectly installed and improperly used or in cases of poor maintenance, these generators can cause either injury to people and/or material damage.
So it is recommended that these tasks be undertaken by qualified personnel who has received adequate training, experience, professional instruction, knowledge of technical standards, specifications and safety standards, knowledge about accident prevention and operation conditions. Equipment for fire extinguishing and notice of first aid should be placed at accessible and visible locations.

2.2. UNPACKING

Prior to shipment, all generators are factory-tested and supplied in perfect operating conditions. All adjusting and machining surfaces are duly protected with corrosion inhibitors. Upon receipt, we recommend to check the boxes to see if any damage has occurred during transportation. If any, contact the carrier, insurance company and Weg Máquinas Ltda. The lack of notice will void the warranty.

When lifting the boxes (or container) it is important to pay attention to the areas appropriated for this purposes well as to check weight of the box along with hoist capacity.
Those generators shipped in wooden boxes can only be lifted by the eyebolts or using forklift machines and never lifted by the shaft or box.
The box should never be turned around. Lifting and lowering of such boxes must be done gently in order to avoid damage to the bearings.
Make a visual inspection after the unpacking has been done. Do not remove the protecting grease from the shaft end neither the stoppers from the terminal boxes. These protection devices should remain in place until the installation is finished.
For generators fitted with shaft locking device, this device must be removed, and the rotor rotated several times by hands. If damages are noticed, contact the carrier and Weg Máquinas Ltda.

2.3. STORAGE

When generators are not immediately unpacked, boxes should be stored in their normal upright position in a dry temperature room, free of dust, dirt, gases, insects and corrosive atmosphere.
Generators must be stored in places free of vibrations in order to avoid bearing damage. For generators fitted with space heaters, these accessories must be kept switched-on. If painting has suffered any damage, it must be repainted to avoid rust. The same applies to machined surfaces when protecting grease has been wasted.

2.3.1 BEARINGS

When generator is kept in stock for a period of six months or less, it is not require to effect a full inspection on the bearings before running it. What has to be done is to rotate manually the shaft monthly.
However, when generator is kept in stock for more than six months, bearings must be regreased, before opération, according to item 5.4.1.3. On the other hand, if generator is kept in stock for approximately 2 year or more, bearings must be disassembled, according to item 5.4.1.5. and washed with ether and checked. After the reassembly, bearings must be regreased according to item 5.4.1.3. of this manual. Generators fitted with shielded bearings must have these bearings replaced when generators are kept in stock for a period exceeding 2 years.

2.3.2. SLEEVE BEARINGS

Sleeve bearing performance depends on adequate installation, lubrication and maintenance. Before assembling or disassembling the bearing, carefully read the instructions contained herein The procedure described in item 4.2.2 refers to assembly and disassembly of bearings used in electric machines with the rotor already mounted.

2.3.3 INSULATION RESISTANCE

When generator is not immediately put into operation, it should be protected against moisture, high temperatures and impurities in order to avoid damage to the insulation. The winding insulation resistance must be measured before operating the generator.
If the environment contains high humidity, a periodical inspection is recommended during storage. It is difficult to determine rules for the actual insulation resistance value for generators as the resistance varies according to environmental conditions (dust, oil, grease, dirt) and condition of the insulating material used and manufacturing process of the generator. A lot of experience is required to decide when a generator is ready for operation. Periodical records will help to take such decision.
The following guidelines show the approximate insulation resistance values that can be expected from a clean and dry generator at 40°C temperature ambient, when test voltage is applied for a period of one minute supplied by the curve of figure 1, as per NBR 5383 Standard.
The RM insulation resistance is given by the formula:

$$Rm = Un + 1$$

Where:

RM – Minimum insulation resistance recommended in Mega Ohm with the winding at a temperature of 40°C;
Un – Rated voltage of the generator in kV.

If the test is performed at a different temperature, it is necessary to correct the reading to 40°C using an insulation resistance variation curve in relation to temperature, given by the generator itself. If this curve is not available, it is possible to use an approximate correction given by the curve of figure 1, as per NBR 5383 Standard.
On new generators, lower values are sometimes obtained as solvents are present in the insulating varnishes which become volatile in a later stage during normal operation. This does not necessarily mean that the generator is not suitable for operation, once the insulation resistance will increase after a certain period of operation.
On old generators, still in operation, higher values are usually obtained. The comparison with values obtained from previous tests on the same generators under identical load, temperature and humidity conditions will be a better indication of the insulation conditions in comparison to the value obtained from a single test. Any sudden or high reduction of the value requires careful attention.
The insulation resistance is normally measured with a Mega-ohmmeter.
If the insulation resistance value is lower than the values obtained through the above mentioned formula, generator must be submitted to a drying process according to item 5.7.

Table 2.1. Guide limits for insulation resistance of electrical machines:

Insulation resistance value	Insulation level
2M or lower	Bad
< 50M OHM	Dangerous
50...100M OHM	Regular
100...500M OHM	Good
500...1000M OHM	Very Good
> 1000M OHM	Excellent

Table 2.2. Polarization Index (ratio between 1 and 10 minutes)

Polarization Index	**Insulation Level**
1 or lower	Bad
< 1.5	Dangerous
1.5 to 2.0	Regular
2.0 to 3.0	Good
3.0 to 4.0	Very good
> 4.0	Excellent

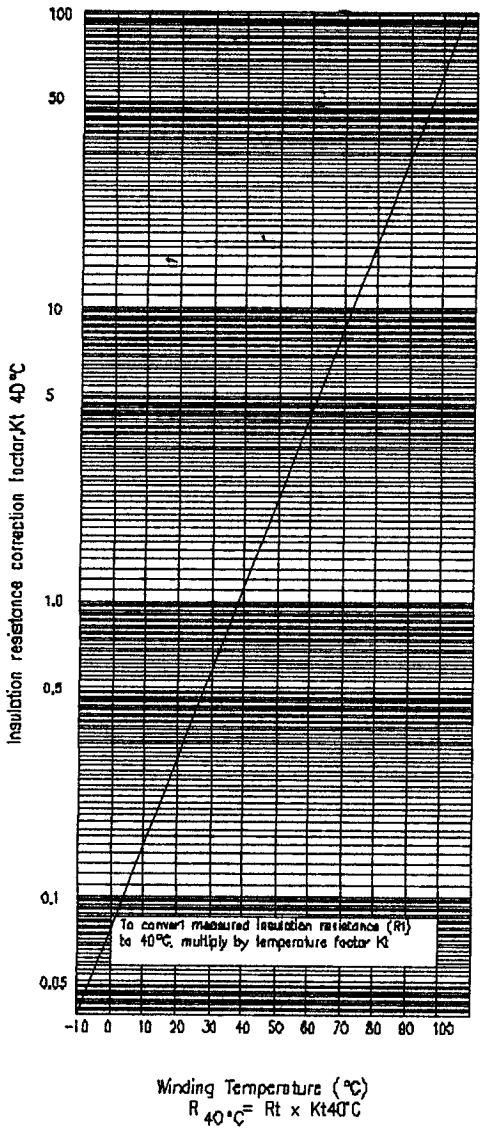


Figure 1

2.4 HANDLING

Use only the existing eyebolts to lift the generator. Never lift the generator by the shaft. Check the generator weight. Lifting and lowering must be done gently in order to avoid damage to the bearings. The eyebolts attached to bearing housing, heat exchanger, endbells, etc, should be used to handle these components only.

3. GENERAL ASPECTS OF THE MAIN MACHINE

The WEG "S" Line Generators (Brushless) are composed of:

a) Main machine
b) Main exciter
c) Static voltage regulator.

Machine with brushes:
a) Main machine
b) Slip rings

3.1 STATOR OF THE MAIN MACHINE

The frame is isolated and made of calendered steel plates. The stator core with its corresponding winding is fitted inside the generator frame.
Low voltage windings are produced for class H insulation. The others are F. Thermal sensors in the lamination core can be fitted as well. The stator is designed based on technical characteristics including electrical and thermal items required by the customer. Additionally, harmonic distortions and evaluations of magnetic noises and vibrations on the lamination core also make part of the design.
The stator coils can be built with round or rectangular wire. In cases of rectangular wire, either low or high voltage, coils are mechanically reinforced in the coil heads to protect against stator failures.
For stator impregnation of low voltage with round wire, polyester varnish is used. For class H, epoxy is then used. For high voltage , VPI system with epoxy is used.

3.1.1 ROTOR OF THE MAIN MACHINE

The rotor accommodates the field winding where the poles are made of steel laminations. A squirrel cage winding for absorbing purposes compensates parallel and abnormal load operations.

NOTE: The machine can be built with flat or salient poles; the rotor is designed to meet mechanical requirements as requested by the customers resulting in good performance and mechanical strength for a successful operation.
The rotor is vacuum impregnated (with epoxy) to ensure high mechanical and electrical strength.

3.2 MAIN EXCITER

For Brushless machines, a main exciter is used as well as a three phase current generator. Depending on the agreement with the customer, they can be placed either inside or outside of the main machine.

3.2.1 STATOR OF THE MAIN EXCITER

The poles accommodate the field coils which are series connected. The connection is made at the terminal block (Bornes I + and K -). Its function is to supply the flux to the exciter rotor. It is fed by DC which is controlled by the voltage regulator based on load requirements, which keeps the voltage constant.
An auxiliary winding can be added to detect abnormal situation in the diodes.

3.2.2 ROTOR OF THE MAIN EXCITER

The rotor of the main exciter is mounted on the main machine shaft. It is made of steel laminations designed with slots that accommodate a star connected three phase winding. The common point of this star connection is not accessible. Each star connection point allow two wires which are connected to the rotating rectifiers seated on two dissipating supports.
From the rectifier come out 2 wires to feed the rotor of the main machine. The rotor is induced by flux of the exciter stator on a three phase AC which will be rectified in a complete wave by the rotating rectifier.

3.2.3 AUXILIARY WINDING

The auxiliary coil for some low voltage machines is made with circular wire.
The auxiliary winding is composed of coil groups fitted in the stator slots of the main machines, isolated in the main winding. This winding will feed the field power of the main exciter in order to guarantee the short circuit current.

3.2.4 SLIP RINGS

The slip ring system is used in cases where a dynamic self performance in the response time is required from the machine. The function of slip rings is to send energy directly to the main machine field through brush contacts.

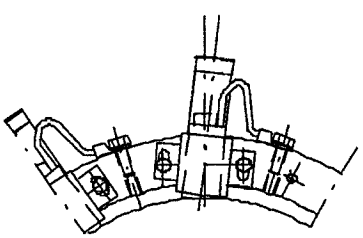
This system requires periodical maintenance. Hence, customer should pay careful attention to several items in order to avoid damage to wound rotor, ring and/or brush system and static exciter Never open the field circuit under load as this can damage rotor insulation as well as to cause injury to operators.
Basic cares include cleaning of dust from brushes, formation of patina, to check if the imposed load current is suitable with brush operation point.
As a general rule, cleaning should be carried out monthly in order to remove the accumulated dust between the rings (see item 4.10).
When disassembling slip rings, care must be taken to reassemble them so as to ensure centralization and avoid ovalization or radial run out.
Correct positioning (100% of contact) of the brushes over the ring must also be ensured. If such procedures are not followed accordingly, problems associated with slip ring and brush wear can occur.

3.3. BRUSH HOLDERS

3.3.1. BRUSH HOLDERS

Brush holders must be set radially to the slip ring and adjusted approximately 4mm away from the contact surface to avoid brush rupture or injury (Fig. 4.4))

INCORRECT



CORRECT

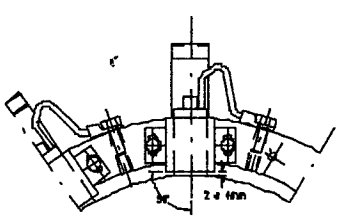


Figure 4.3 - Air gap between brush holder and ring contact surface.

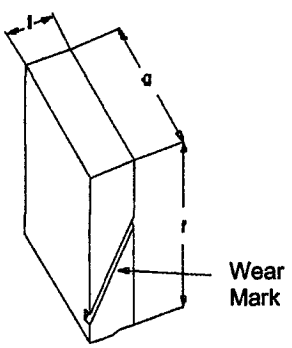
Brushes must be checked weekly to ensure free sliding inside the brush-holder.

3.4. BRUSHES (FOR SLIP RING MOTORS)

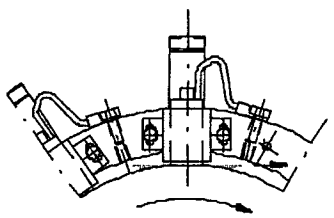
There is a factory-specified brush type for each electric motor fitted with slip rings.
In case motor is operating below its rated output (low load) or intermittent load, the set of brushes (brush type and quantity) must be adjusted to the actual operating conditions, avoiding in this way motor damage.
This adjustment must be done with the help of Weg Máquinas Ltda.

Never use assorted brushes of different types on the same rings.
Any change of brush type must be authotized by WEG Máquinas Ltda, as different brushes cause performance alterations to the machine in operation.
Brushes should be constantly checked during operation. Any brush presenting signs of wear should be exceeding the mark indicated figure 4.5, immediately replaced.

Figure 4.5



At the time of replacement and whenever feasible, all brushes should be replaced. Having replaced the first one, the second brush should be replaced after a suitable running-in-period.
Replacement brushes should be sanded to set perfectly on the ring surface curvature (min. 75%). On machines that always rotate in the same direction, the brushes should be set in a single direction only. During the backward movement of the shaft the brushes must be lifted (fig.4.6.)



3,5. EXCITATION AND DISEXCITATION

The self excitation is started by the machine residual voltage or by a pre-excitation which is supplied by a bank of batteries.
During maintenance services, machine must remain stopped as the disexcitation is not sufficient.
The disexcitation is made when the generator is stopped or when regulator is switched off (if any is available on the panel).

- Disexcitation for Brushless machines:

A free circuit in the exciter stator can be fitted in parallel with the regulator. When generator is de-energized, the excitation current flows through a discharge resistance which leads to a quicker main machine disexcitation.

- Disexcitatiof for slip ring machines:

The disexcitation process is identical to previous one. The difference is that here the disexcitation is calculated to dissipate field energy.
Note: **There is also a "Crow-bar" system which protects the rotor from losing the main machine synchronism.**

3.6. VOLTAGE REGULATOR

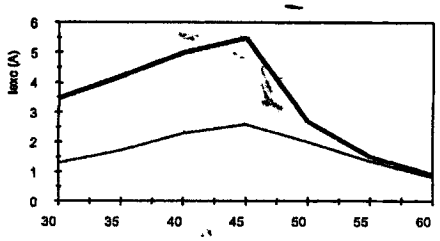
The voltage regulator is an electronic device and serve to keep the voltage constant independently from the type of load.
For technical details and information about operation, functions, connections, adjustments, abnormal situations, etc, see the Voltage Regulator Manual.
The voltage regulators are mocriprocessed and analogic, with parallel operation between two machines and with the power supply. Power factor correction is applied.

Check in the Regulator Manual the correct connection diagram of the said regulator. A wrong connection can result in a complete regulator and/or generator winding burn out.

3.7. SUBFREQUENCY PROTECTION

Before operating the generator, the protection against sub-frequency must be adjusted to 90% of the rated frequency (it leaves the factory already having such adjustment) or keep the voltage regulator switched off until the set gets to the rated speed in order to avoid winding overcurrents in the auxiliary winding of the generator excitation.

U/F Operation



__ Enable
__ Unable

3.8. ADJUSTING POTENTIOMETER OF THE THEORETICAL VALUE

Each machine can be fitted with an adjusting potentiometer of the theoretical value (optional) which permits a voltage regulation usually in the range of 15% of the rated value.
This range is also sufficient on the parallel operations to the power supply for reactive power regulation.
For more details, see the Voltage Regulator Manual.

3.9. STATIC EXCITER (SLIP RING GENERATORS)

This is considered a voltage regulator with extra functions. Its main difference is to supply integral power to main machine rotor. These are also microprocessed voltage regulators requiring more space for installation of panels as well as power transformer

4. INSTALLATION

Electric machines should be installed in locations of easy access for periodical inspections and removal of equipment while performing maintenance services, if required.
Under no circumstances, generators can be installed in enclosed places which may block or reduce the free circulation of cooling air.
Enclosed rooms will cause overheating resulting in reduction of insulation lifetime leading to a possible generator burning out.

IMPORTANT: The shaft locking device must be used whenever generator needs to be removed from the base (uncoupled from driven machine) to avoid transportation damage.

To ensure good performance and durability to the generator it is essential to match the degree of protection of the equipment with the installation environment.

4.1. ROTATION DIRECTION

The "S" line generators are suitable to operate on both CW and CCW rotation directions. However, the phase sequence is adjusted for **CW** (viewed from the drive end side).
As per VDE 0530, the generator terminals are identified in such a way that the alphabetical sequence of the connectors 1,2 and 3 correspond to the phase sequence, when the rotation direction is CW.
If a generator requires CCW rotation direction, phase sequence must be exchanged. We recommend to check the phase sequence and rotation direction before operating the generator..

4.2. MECHANICAL ASPECTS

4.2.1. FOUNDATIONS

The generator base must be leveled and free of vibrations.
The type of base to be built on will depend on the type of ground at the installation site or on the floor capacity.
If the foundation design is not correctly made, vibration problems can occur on the unit (foundation, generator and driven machine)

Note: On the concrete base, a metallic plate to support the leveling bolt must be provided.

4.2.1.1. METALLIC BASES

Metallic bases must have a flat surface under generator feet in order to avoid frame deformation. The bearing housing surface should be designed in such a way that under motor one can place 2mm thickness shims approximately.
Generators should not be removed from their common metallic bases for alignment; metallic bases should be leveled on the actual foundation (using other leveling devices).
When a metallic base is used to adjust the shaft end height, this must be leveled on the concrete base.
After the base has been leveled, foundation studs tightened, and the coupling checked, the metal base and the studs are then cemented

4.2.2. ALIGNMENT/LEVELING

The generator must be accurately aligned with the driven machine, particularly in cases of direct coupling.

An incorrect alignment can cause bearing damage, vibrations and shaft breaking.
The best way to ensure correct alignment is to use dial indicator placed on each coupling half, one reading radially and the other axially.
In this way, simultaneous readings can be informed and one can check any parallel (Figure 2.1) or concentricity deviations (Figure 2.2) by rotating the shaft. The dial indicator should not exceed 0.05mm. If the operator is sufficiently skilled, he can obtain alignment with clearance gauge and a steel ruler, providing that the couplings be perfect and centered (Figure 2.3).
A measurement at 4 different points of the circumference should not give a reading difference higher than 0.03mm.

Figure 2.1 – Radial clearance (concentricity)

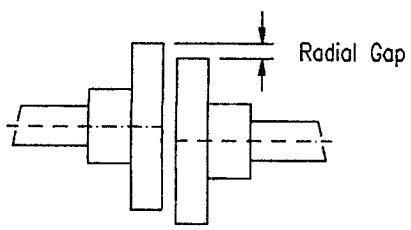


Figure 2.2 – Angular clearance (parallelism)

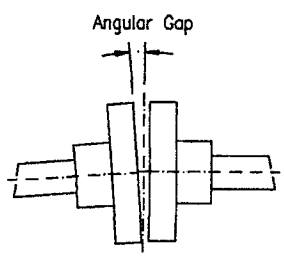
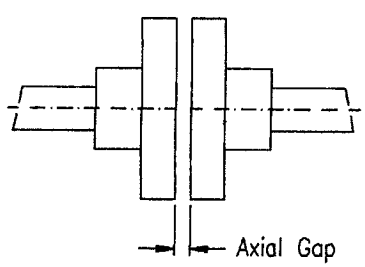


Figure 2.3 – Axial clearance



On the alignment/leveling it is important to take into consideration the temperature effect over the generator and driven machine. The different expansion levels of the coupled machines can modify the alignment/leveling during generator operation.
After the set is perfectly aligned (either at cold or at hot) generator must be bolted, as shown in fig 3..

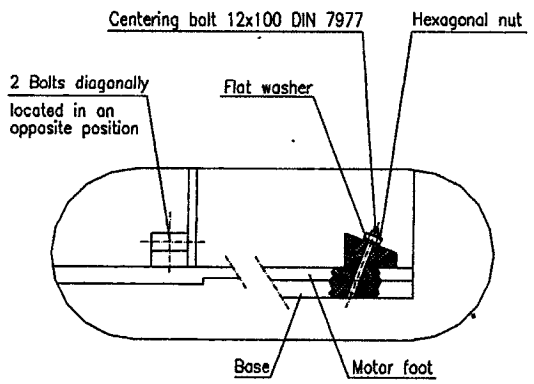


Figure 3

There are instruments which use visible laser ray added by specific computer programs that can perform and ensure high precision alignment.

Note: Bolts, nuts and washers can be supplied with the generators, if required.

4.2.3. DIRECT COUPLING

Only appropriate couplings should be used, suitable exclusively for the torque transmission without causing transversal forces. Shaft centers of generators and drive machine, must be absolutely aligned either for flexible or any other type of coupling. The flexible coupling is used to absorb vibrations and to compensate small assembly disalignments. All types of coupling arrangements must be assembled or disassembled using proper devices and never using hammer.

4.2.4. – COUPLING ARRANGEMENT FOR SLEEVE BEARING GENERATORS – AXIAL CLEARANCE

Generators fitted with sleeve bearings should be directly coupled to the driven machine or even using a gearbox. Pulley/belt coupling is not recommended.

These sleeve bearing generators have three identification marks on the shaft end. The central mark (red painted) indicated the magnetic center; the other two indicate the limits for the rotor axial displacement

When coupling the motor, the following aspects must be considered:

- Bearing axial clearance which is shown on the chart below for each bearing size.
- Axial displacement of the driven machine, if any.
- Maximum axial clearance allowed by the coupling.

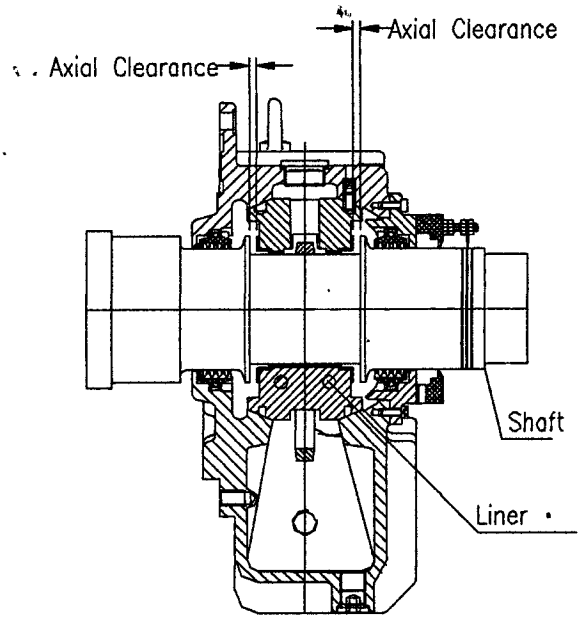
Clearances applied to sleeve bearing generators manufactured by Weg	
Bearing size	Overall axial clearance (mm)
9	3+3 = 6
11	4+4 = 8
14	5+5 =10
18	7.5+7.5 = 15
22	12+12 = 24
28	12+12 = 24

The generator must be coupled in such a way that the arrow attached to the bearing frame be positioned exactly on the central mark (red painted) while motor is in operation.

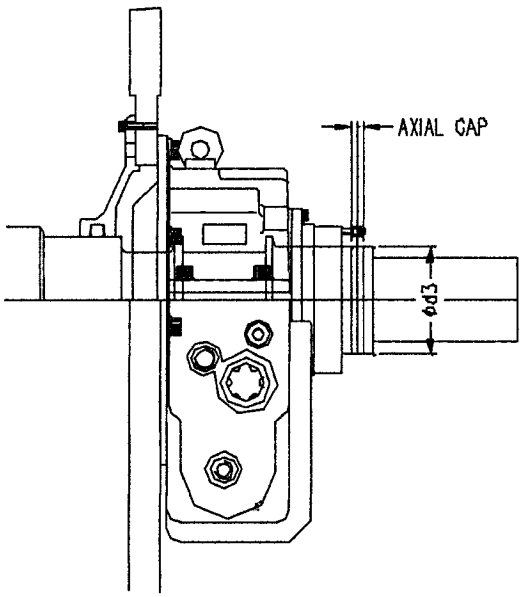
During motor starting or even under operation, rotor should move freely between the two external lots if the driven machine creates any axial force on the motor shaft. Under no circumstance, the generator can operate continuously with axial force on the bearing.

Sleeve bearings normally used by Weg Maquinas are not designed to withstand axial forces continuously.

Figure 2 below shows part of the drive end bearing highlighting a basic configuration of the shaft/bearing set as well as axial clearances.



The figure below shows part of the bearing frame where the arrow indicates the magnetic center and the three marks on the shaft.



4.3 ELECTRICAL ASPECTS

4.3.1. PROTECTIONS

4.3.1.1. GENERATOR:

Weg "S" line generators are supplied with overheating protection devices installed in the stator windings. These devices will operate as tripping as follows:

4.3.1.2. TEMPERATURE LIMITS FOR WINDINGS

The temperature of the winding hottest point must be kept below the thermal class limit.
The total temperature corresponds to the sum of ambient temperature plus temperature rise (T) plus the difference between average temperature of the winding and the hottest point.
By standard, maximum ambient temperature is 40°C. any temperature above this is considered special.
The temperature values and the permissible total temperature at the hottest point are given in the chart 4.1.

Insulation class		B	F	H
Ambient temperature	°C	40	40	40
T = Temperature rise (resistance method)	°C	80	100	125
Difference between hottest point and average temperature	°C	10	15	15
Total: hottest point temperature	°C	130	155	180

Chart 4.1.

THERMOSTAT (BIMETALLIC): These are bimetallic thermal detectors with normally closed silver contacts and they trip at pre-determined temperatures. Thermostats are series-connected or independent, according to connection diagram given.

THERMISTORS (PTC or NTC): They are thermal detectors composed of semi-conductors which sharply change their resistance when reaching a set temperature. They are series-connected or independent, according to connection diagram given.

NOTE: Thermostats and thermistors are connected to a control unit which cuts-off the generator power supply or switches-on an alarm system.

RESISTANCE TEMPERATURE DETECTORS (RTD's): RTD's are resistance thermal detectors usually made of platinum.
Basically, RTD's operate on the principle that the electrical resistance of a metallic conductor varies linearly with the temperature. The detector terminals are connected to a control panel, usually fitted with a temperature gauge.
Normally WEG generators are usually supplied with one RTD per phase and one per bearing where these protective devices are adjusted for alarm and subsequent switched-off (for extra safety reasons, it is possible to fit two RTD's per phase).

NOTE:

NOTE:

1) If required by the application, other protective devices must be used, besides those indicated above.
2) Table 4.2 shows the temperature values in relation to the Ohmic resistance measured.
3) It is recommended to adjust the relays as shown below:

Class F
Alarm: 140°C
Tripping: 155°C
Class H
Alarm: 155°C
Tripping: 180°C

Alarm and tripping values can be defined based on experience. However, they can not exceed the values given herewith..

Tabela 4.2 – Variation of Platinum RTD's

Formula: Omega – $\frac{100}{0.386}$ = 0 C

C	0	1	2	3	4	5	6	7	8	9
0	100.00	100.39	100.78	101.17	101.56	101.95	102.34	102.73	103.12	103.51
10	103.90	104.29	104.68	105.07	105.46	105.95	106.24	106.63	107.02	107.40
20	107.79	108.18	108.57	108.96	109.35	109.73	110.12	110.51	110.90	111.28
30	111.67	112.06	112.45	112.83	113.22	113.61	113.99	114.38	114.77	115.15
40	115.54	115.93	116.31	116.70	117.08	117.47	117.85	118.24	118.62	119.01
50	119.40	119.78	120.16	120.55	120.93	121.32	121.70	122.09	122.47	122.86
60	123.24	123.62	124.01	124.39	124.77	125.16	125.54	125.92	126.31	126.69
70	127.07	127.45	127.84	128.22	128.60	128.98	129.37	129.75	130.13	130.51
80	130.89	131.27	131.66	132.04	132.42	132.80	133.18	133.56	133.94	134.32
90	134.70	135.08	135.46	135.84	136.22	136.60	136.98	137.36	137.74	138.12
100	138.50	138.88	139.26	139.64	140.02	140.39	140.77	141.15	141.53	141.91
110	142.29	142.66	143.04	143.42	143.80	144.17	144.55	144.93	145.31	145.68
120	146.06	146.44	146.81	147.19	147.57	147.94	148.32	148.70	149.07	149.45
130	149.82	150.20	150.57	150.95	151.33	151.70	152.08	152.45	152.83	153.20
140	153.58	153.95	154.32	154.70	155.07	155.45	155.82	156.19	156.57	156.94
150	157.31	157.69	158.06	158.43	158.81	159.18	159.55	159.93	160.30	160.67

NOTE: When generators are supplied with accessories T-box, connection terminals for thermal protectors and other accessories are fitted in this T-Box. Otherwise, accessory terminals will be fitted in the main T-box.

4.3.1.3. IN THE PANEL:

The protections in the panel are defined by customer based on the application requirements. In table 4.3 there are some usual protections installed in the control panel.

Table 4.3

POWER	PROTECTIONS
Up to 150 Kva – low voltage	50/51 – 52/59
From 150 to 1000KVA – low voltage	27-49-50-59-50/51
Above 1000KVA – low voltage	27-32-49-50G-51V-52-59
Up to 3000KVA – medium voltage	CP-PR-27-32-49-50G-51V52-59
From 3000KVA to 7500Kva – medium voltage	CP-PR-32-40-46-49-50G-51V-52-59-87
Above 7500KVA – medium voltage	CP-PR-27-32-40-46-49-50G-51V-52-59-78-81-87

SYMBOLOGY:

CP – capacitor
PR – lightning arrester
27 – subvoltage
2 – reverse output
46 – current unbalance
49 – overload
50G – ground over-current
50 – instantaneous over-current
51 – timing over-current
51V – voltage locking over-current
52 - breaker
59 – overvoltage
64 – field ground
78 – phase angle
81 – frequency
86 – interruption relay
87 – differential
40 – lost of field

NOTE: The use of protection 59 (overvoltage) is mandatory to avoid damage to generator and driven machine.

4.3.2. SPACE HEATERS –

When generators are fitted with space heaters to avoid water condensation during long periods of standstill, these devices must be kept switched-on. As soon as motor is restarted, space heaters must be deenergized immediately.
A dimensional drawing and a specific nameplate attached to the motor indicate the supply voltage and the characteristics of the space heaters installed.

4.4. COMMISSIONING

Generators leave the factory with some safety precautions for transportation. So before putting them into operation, these protections (if any) should be removed.

4.4.1. PRELIMINARY INSPECTION

Before starting the generator for the first time or after a long period of standstill, check the following items:

1) Is the generator clean? Were all packing materials and protection elements removed?
2) Are coupling elements in perfect condition and duty tightened and greased, if required?
3) Is generator aligned?
4) Are bearings duly lubricated?
5) Are thermal protector grounding and surface heaters leads duty connected (if any)?
6) Is winding insulation resistance within prescribed values?
7) Were all objects such as tools, measuring instruments and alignment devices removed from generator operating area?
8) Is generator fixed correctly?
9) Are all connections made according to the generator connection diagram?
10) Is voltage regulator correctly connected according to its installation manual?
11) Are power supply connectors duly connected to main terminals in order to avoid short circuit or get them loose?
12) Is generator duly grounded?
13) When generator is started at no load, does it rotate freely without abnormal noise? Is rotation direction correct (to reserve the rotation, invert any of two power supply leads)
14) Is generator cooling OK?

4.4.2. START-UP

Once all the above items have been entirely accomplished, generator is then ready for the start-up. During operation, the automatic excitation starts working and, under rated speed, the generator can take load.
Once the generator is started, excite it up to its rated voltage.
Once the generator is excited up to its rated voltage, then it is ready to take load immediately.

4.4.3. OPERATION

Operate the generator until it gets to the thermal stability and check for any noise, abnormal vibrations or excessive heating. If there are significant vibration changes on the set from start up and the thermal stability conditions, check the alignment, leveling and generator coupling arrangement along with drive machine. Make corrections, if required.
All measuring and control equipment must be checked on a permanent basis for any deviation. If any is found, it must be corrected.
For further questions, contact Weg Maquinas Ltda.

4.4.4. PARALLEL OPERATION

All the generators can be used on parallel operations with the power supply or with other similar generators as long as they are equipped with absorbent windings along with voltage regulator and an appropriate system for the operation.

4.4.5 .SWITCHING OFF

Even after the de-excitation, residual voltage is still present. This means that only after the complete stop, any service on the generator can be carried out.
The non observation of these procedures can be harmful to people's life.

5. MAINTENANCE

A well scheduled maintenance service for generators, when properly used, includes a periodical inspection of the insulation condition, temperature rise (winding and bearings), wears, bearing lubrication, bearing life time, checking of the fan, fan air flow and vibration levels.
In case one of the items are not followed accordingly, you might have unexpected equipment breakdown. Inspection cycles depend on the conditions under which generator operates.
Soft brush or clean cotton rags should be used to clean the generators. A jet of compressed air can be used to remove any non-abrasive dust

from the fan cover or any accumulated grime from the fan or cooling fins.
Oil or impregnated impurities can be removed with rags soaked in a appropriate solvent.
Terminal boxes of IP 54 protection generators should also be cleaned; their terminal should be free of oxidation and in perfect mechanical condition.

Based on the humidity content of the installation site, generators used for emergency cases must be operated from 2 to 3 times a month for at least 3 hours each time.

5.1. CONNECTION DIAGRAMS

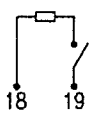
Below are the identification numerals for terminals and connection diagrams showing how they must be connected.

IDENTIFICATION OF THERMINALS

- 1 to 12, N - POWER TERMINALS
- UR, VR, WR and N - REFERENCE AND REGULATOR POWER SUPPLY VOLTAGE
- 13, 14 and 15 - AUXILIARY EXCITER OR AUXILIARY COIL PHASES
- I and K - MAIN EXCITER I (+) . K(-) OR SLIP RING FIELD
- 16 to 19 - SPACE HEATER (WITH OR WITHOUT THERMOSTATO)
- 20 TO 25 - THERMOSENSOR RTD (PT100) -STATOR
- 26 to 31 - THERMISTOR (PTC) - STATOR
- 32 to 37 - THERMOSTAT (KLIXON, COMPELA) - STATOR
- 38 to 41 - THERMOSENSORS - BEARING
- 42 to 45 - THERMISTORS - BEARING
- 46 to 49 - THERMOSTATS - BEARING
- 50 to 52 - TACHO-GENERATOR
- 53 to 55 - WATER FLOW SWITCH - RADIATOR
- 56 to 59 - WATER LEAKAGE DETECTOR - RADIATOR
- 60 to 63 - WATER THERMOMETER - RADIATOR
- 64 to 65DIODES FAILURE DETECTOR
- 66 to 77 - CURRENT TRANSFORMER

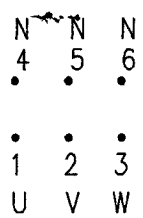
88 to 91 - THERMOMETOR (BEARING)

Connection Diagram for space heater

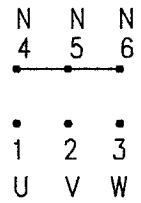


Connection diagram for space heater with thermostat

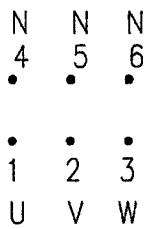
CONNECTION DIAGRAM FOR POWER TERMINALS



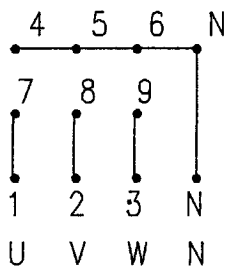
Y CONN. - 6 TERMINALS NEUTRAL CLOSE



LIG.Y-6 TERMINALS NEUTRAL OPEN

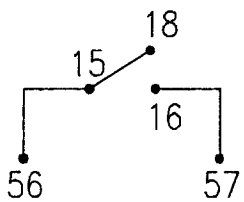


LIG.Y-6 TERMINALS NEUTRAL CLOSE

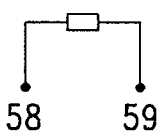


YY CONN. - 10 TERMINALS

CONNECTION DIAGRAM FOR WATER LEAKAGE PROTECTION

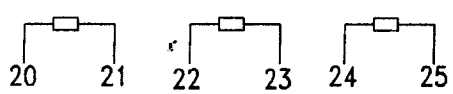


MAX. 250 Vac
MAX. 0.5 A

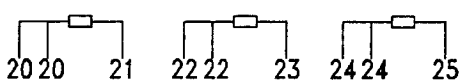


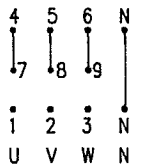
POWER SUPPLY VOLTAGE 110 OR 220Vac - 4 VA

PT100 1 PER PHASE

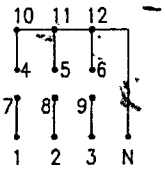


PT100 1 PER PHASE WITH 3 LEADS

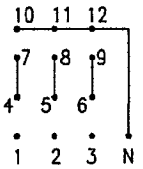




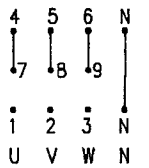
Y-CONN. 10 TERMINALS



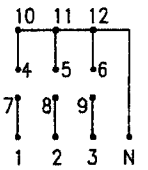
YY CONN. 12



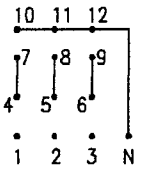
Y CONN. 12 TERMINALS



Y CONN. 10 TERMINALS

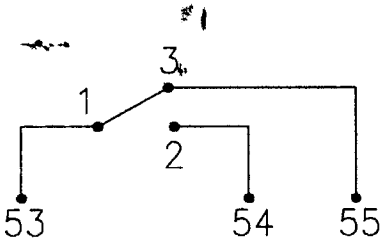


YY CONN. - 12 TERMINALS

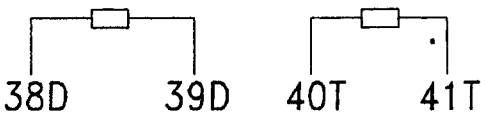


Y CONN.- 12 TERMINALS

CONNECTION DIAGRAM FOR WATER FLOW SWITCH

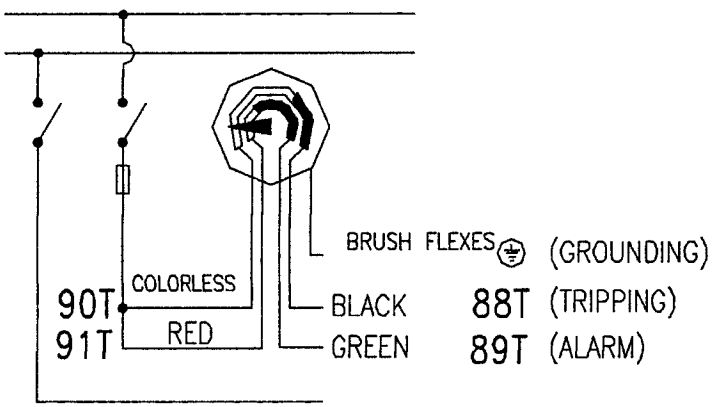


CONNECTION DIAGRAM FOR BEARING PROTECTION PT100

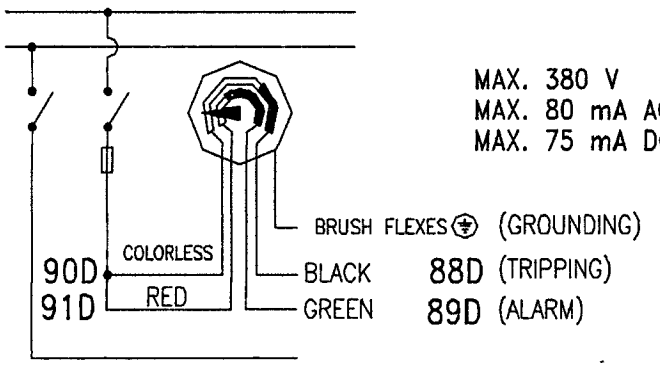


D.E. BEARING

THERMOMETERS



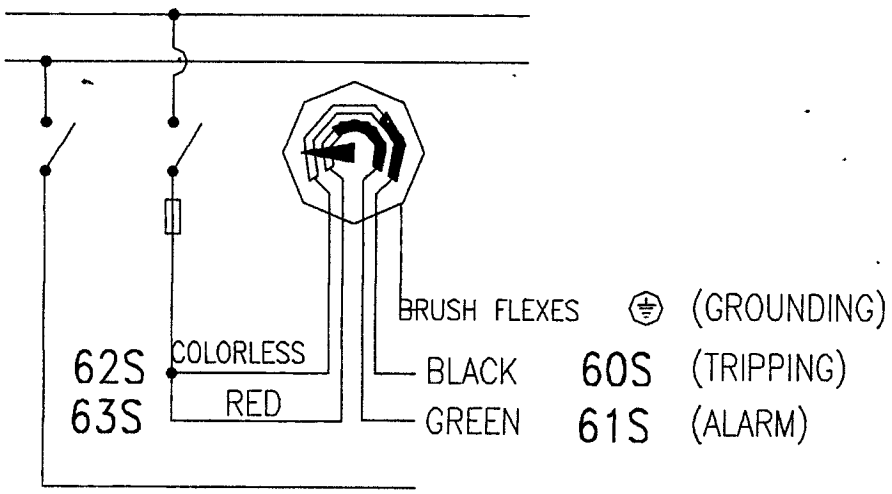
NDE BEARING



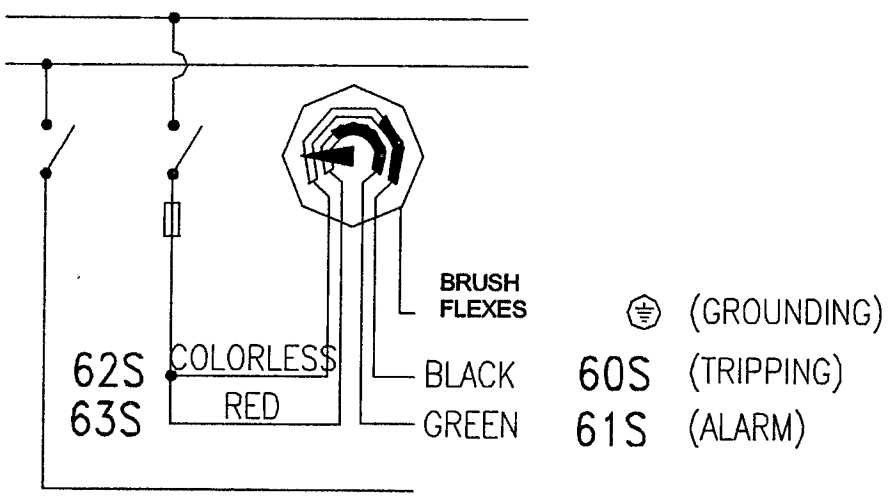
DE BEARING

MAX. 380 V
MAX. 80 mA AC
MAX. 75 mA DC

CONNECTION DIAGRAM FOR WATER THERMOMETERS (RADIATOR)



WATER INLET



WATER OUTLET

Suffix: "E "for inlet;
"S" for outlet

NOTES:

For thermistors (PTC) and thermostats, numerals should be changed as per legend.
For 2 thermistors per phase, suffixes are added such as "A " for alarm and "D" for tripping.
For 3 thermistors per phase, suffixes will be added such as "A" for alarm, "D" for tripping and "R" for standby

Soft brush or clean cotton rags should be used to clean the generators. A jet of compressed air should be used to remove non-abrasive dust from the fan cover and any accumulated grim from the fan and from the frame.

Oil or damp impregnated impurities can be removed with rags soaked in a suitable solvent.
Generators supplied with degree of protection IP54, should also have the terminal box duly cleaned; its terminals must be free of any oxidation or grease and in perfect mechanical condition.

Bearing temperature control also makes part of a routine maintenance. The temperature rise can not exceed 60°C, measured on the external bearing cap ($\Delta T = 60^{\circ}$ C).

Constant temperature control can be monitored by means of external thermometers or embedded thermal elements.

5.2. COMPLETE MAINTENANCE

- Clean the dirty winding with a soft brush. Grease, oil or other impurities can be removed from the winding with a rag soaked in alcohol or a suitable solvent. Dry these windings with a jet of compressed air.
- A jet of dry compressed air should be used to clean the bearings and the air ducts of the stator and rotor.

- Drain the condensed water and clean the inside of the terminal boxes as well as the slip rings.

Measure the insulation resistance (see table 2.1), or polarization index as per tables 2.2

5.3. RADIATOR – AIR COOLER WITH ENCLOSED CIRCUIT

Description

5.3.1. GENERAL ASPECTS

The radiator is a surface heat exchanger designed to dissipate heat from electric equipment or others on an indirect way, that is, , enclosed circuit air and cooled by the radiator after removing the heat coming from the equipment which must be cooled down.
Clean water should be used as secondary coolant.
In this way, the heat dissipation is made from the equipment to the surrounding medium and from this to the water.

5.3.2. COMMISSIONING

Monitor first the temperature and then control the cooler and correct water flow, if required. Adjust water pressure, if required, to test pipes resistance and cooler.
For operation control, we recommend to provide thermometers on the air side and on the water pipes, before and after the cooler and record the temperatures at certain intervals of time. When installing thermometers, recording and signaling instruments could be installed as well (horn, lights) on certain locations.

5.3.3. MAINTENANCE (RADIATOR)

Using aggressive water (sea water or chemical products), we recommend independently from amount of dirty in the cooler, to check the heads and glasses affected by the water when corrosion is present, at certain time intervals not exceeding one year of operation.
If corrosion is noticed, a corrosion resistant material should be provided (for example, similar protection plate) in order to provide a better protection to affected parts. The external layer of all parts of the cooler must be always kept in perfect condition.

5.3.4. CLEANLINESS (RADIATOR)

Using clean water, the cooler can remain in operation for several years without requiring any cleanliness. When using dirty water, cleanliness is required from 6 to 12 months. Excess of impurities in the water will cause increase of temperature. When the temperature of the cold air, under identical operation conditions, exceeds a pre-determined value, it means pipes

are dirty. Proper brushes should be used to clean these pipes.
When cleaning the heads, it must be disconnected from the glass. Foe new assembly, joints should be checked and, if required, replace them. Dirty water can be removed using drains available on the heads or pipes.

6. LUBRICATION

6.1. GREASE LUBRICATED BEARINGS

The purpose of this maintenance is to extend bearing life time as much as possible.
Maintenance includes:

a) General verification on the bearings.

b) Lubrication and cleanliness.

c) Detailed verification of bearings.

Generator noise level should be measured at regular intervals ranging from 1 to 4 months. A well-tuned ear is perfectly capable to distinguish unusual noises, even using rudimentary tools such as a screw driver, etc.
For a more accurate analysis of bearings, sophisticated equipment is recommended.

Bearing temperature control is also part of a routine maintenance. When bearings are lubricated with greases recommended in item 4.2.1.2 temperature rise should not exceed 60 C, measured on the external bearing cap
(T = 60°C/max. ambient. = 40°C, absolute temperature = T + ambient).
Temperature can be monitored on a permanent basis by means of external thermometers or by embedded thermal elements.
Alarm and tripping temperatures for ball or roller bearings can be set for 90°C and 100°C.

Weg generators are usually fitted with grease lubricated ball or roller bearings. Bearings must be lubricated to avoid metal to metal contact and also for protection against corrosion and wear.
Lubrication properties deteriorate in the course of time and due to mechanical operation. Additionally, bearings are subject to contamination under working conditions. When lubrication useful life is over, bearings must be replaced.

6.1.1. LUBRICATION INTERVALS

Weg generators are supplied with sufficient amount of grease for a long operation period.
Lubrication intervals, amount of grease and bearings used on the generators are shown on the tables attached as guide values.
Lubrication intervals depend on the size of the generator, operating speed working conditions, type of grease used and on the operating conditions.
The lubrication period and bearing type for each generator are given on the generator nameplate.

6.1.2. QUALITY AND QUANTITY OF GREASE

Correct lubrication is important for proper bearing operation. It means to say that the grease must be applied correctly. Insufficient or excessive quantity of grease are harmful to the generator.
Excess greasing causes overheating due to high resistance on the rotating parts and specially due to compacting of the lubricant, which causes the grease to lose its lubricating properties.
This can cause leakage allowing the grease to penetrate inside the generator affecting coils, rotor and stator.

For lubrication of electric machine bearings lithium and bisulfate of molybdenum base grease are commonly used as they present good mechanical stability, insoluble in water and have a meting point of approximately 200 C.
These types of grease should be never mixed with sodium or calcium base grease.

6.1.3. GREASE COMPATIBILITY

The compatibility of different types of grease can create occasional problems. When the properties of the mixture remain within the individual property range of the greases, we can say the greases are compatible To avoid any possible incompatibility grease problem, we recommend to perform an appropriate lubrication which can be summarized as follows: after removing the old grease and cleaning the grease cavity accordingly, new grease must be pumped in. When this procedure is not possible, pump in new grease by pressure.. This must be repeated until the old grease is drained out
As a general rule, greases with same saponification type are compatible, however, depending on the mixture content, they can be incompatible. Therefore, different types of

greases is not recommended. Before doing that, contact Weg plant and/or Weg service agent Same and basic oils can not be mixed either as they will not produce a homogeneous mixture. On this case, hardening or a softening (or drop of the resulting mixture melting point) can occur.

6.2. GREASE LUBRICATED BEARINGS

The purpose of this maintenance is to extend bearing life time as much as possible.
Maintenance includes:

b) General verification on the bearings.

b) Lubrication and cleanliness.

c) Detailed verification of bearings.

Generator noise level should be measured at regular intervals ranging from 1 to 4 months. A well-tuned ear is perfectly capable to distinguish unusual noises, even using rudimentary tools such as a screw driver, etc.
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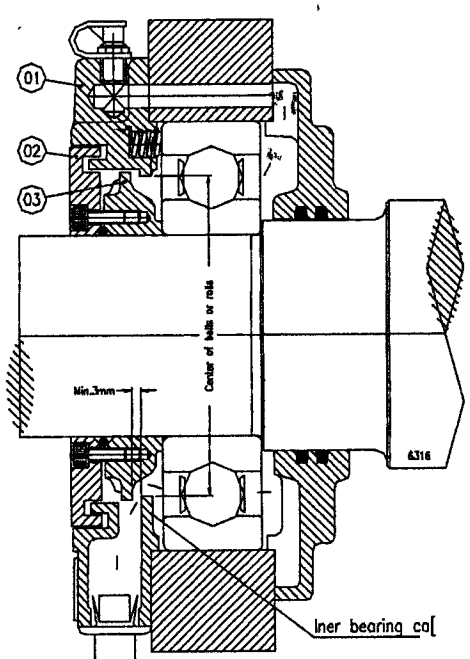

Figure 4.1 – Bearings and lubrication systems.

BEARING LUBRICATION STEPS

1. Remove the grease relief cover.
2. Clean the area around the grease fitting with a clean cotton fabric.
3. With the generator in operation, add grease with a manual grease gun until the old grease starts to drain out or up to the point the amount of grease recommended in Tables herewith indicated has been injected.
5. **Leave the generator running long enough to drain out all excess of grease.**

6.2.1. LUBRICATION INTERVALS

Weg generators are supplied with sufficient amount of grease for a long operation period.
Lubrication intervals, amount of grease and bearings used on the generators are shown on the tables attached as guide values.
Lubrication intervals depend on the size of the generator, operating speed working conditions, type of grease used and on the operating conditions.
The lubrication period and bearing type for each generator are given on the generator nameplate.

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Correct lubrication is important for proper bearing operation. It means to say that the grease must be applied correctly. Insufficient or

excessive quantity of grease are harmful to the generator.
Excess greasing causes overheating due to high resistance on the rotating parts and specially due to compacting of the lubricant, which causes the grease to lose its lubricating properties.
This can cause leakage allowing the grease to penetrate inside the generator affecting coils, rotor and stator.

For lubrication of electric machine bearings lithium and bisulfate of molybdenum base grease are commonly used as they present good mechanical stability, insoluble in water and have a meting point of approximately 200 C.
These types of grease should be never mixed with sodium or calcium base grease.

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As a general rule, greases with same saponification type are compatible, however, depending on the mixture content, they can be incompatible. Therefore, different types of greases is not recommended. Before doing that, contact Weg plant and/or Weg service agent
Same and basic oils can not be mixed either as they will not produce a homogeneous mixture. On this case, hardening or a softening (or drop of the resulting mixture melting point) can occur.

6.2.4. LUBRICATION INSTRUCTIONS

All high and low voltage generators are fitted with grease fittings for bearing lubrication. The lubrication system was designed in such a way to allow, when re-greasing, the renewal of all grease from the bearing races through a grease relief which at the same types prevents from penetrating dust or other contaminants harmful to the bearings.
This grease relief also avoids injury to bearings from the already known problem of over-greasing.

It is recommended to re-lubricate while the generator is operating so as to allow the renewal of grease in the bearing housing.
If this procedure is not possible due to rotating parts near the grease nipple (for example, pulley) which can be harmful to operator life, the following procedures should be taken:

NOTE: Grease fittings must be cleaned before greasing the generator to avoid penetration of any solid material into the bearings.

For lubrication, use only manual grease gun.

BEARING LUBRICATION STEPS

1. Remove the grease relief cover.
6. Clean the area around the grease fitting with a clean cotton fabric.
3. With the generator in operation, add grease with a manual grease gun until the old grease starts to drain out or up to the point the amount of grease recommended in Tables herewith indicated has been injected.
4. Leave the generator running long enough to drain out all excess of grease.

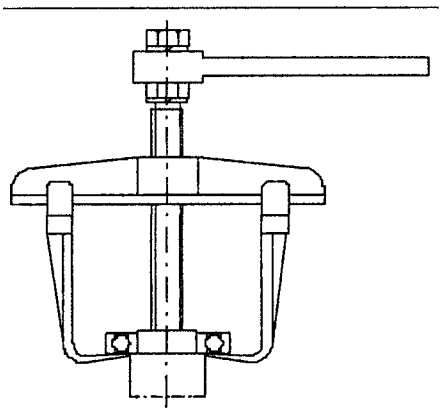


Figure 4.2 – Bearing extractor

6.2.5. REPLACEMENT OF BEARINGS

When removing the bearing cap, avoid damage to the rotor and stator cores by filling the air gap between rotor and stator with stiff paper of a proper thickness.
Providing that suitable tooling (bearing extractor with 3 grips as shown in Fig 4.2) is employed, disassembly of bearings is not difficult.
The extractor grips must be applied on the side wall of the inner ring to be stripped or on the an adjacent part.

To ensure perfect operation and no injury to bearings, it is essential that the bearing assembly be carried out under conditions of complete cleanliness and by qualified personnel. New bearings should not be removed from their packages until they are mounted. Before mounting a new bearing make sure that the shaft does not present any rough edge or signs of hammering.

During assembly, bearing should not be subject to direct blows. To make the assembly easier, it is recommended to heat up (inductive heater) the bearing. The aid used to press or strike the bearings should be applied to the inner ring.

6.2.6. SLEEVE BEARINGS

6.2.6.1. GENERAL INSTRUCTIONS

A proper maintenance of sleeve bearings include a periodical checking of the level and actual condition of the lubricant, verification of noise and vibration levels of the bearings, follow-up of the operating temperature and fastening of fixing and assembly bolts.
The frame must be kept clean, free of dust, oil and dirt to provide easy cooling process.
Threaded holes for connecting the thermometer, oil sight glass, oil inlet, oil circulating pump or reading thermometer in the oil sump are provided on each side so that all connections can be made on the right or left side of the bearing housing.
The oil drain plug is located on the underside of the bearing housing.
For those cases where independent oil lubricating bearing are provided, the outlet pipes should be connected at the oil sight glass level.
If the bearing is electrically insulated, the spherical bearing line seat surfaces on the frame are coated with an insulating material. Never remove such protection.
The anti rotating pin is also insulated and the shaft seals are manufactured with a special non-conductive material.
Temperature monitoring equipment in contact with bearing liner should also be insulated.
Water-cooled bearings are provided with a cooling coil installed. Care should be taken to protect the connections from damage during transportation and installation..

6.2.6.2. DISASSEMBLY OF SLEEVE BEARING (TYPE "EF / EM = B3", "ER / EG = D5 / D6")

To disassemble the bearing liners and all associated parts from the bearing housing, carry out the following instructions. Carefully store all disassembled parts in a safe room. (See Figure 4.3).

Drive end side

-Thoroughly clean the outside of the bearing housing. Loosen and remove the oil drain plug (1) at the bottom of the bearing housing allowing complete drainage of the lubricant.
-Remove the bolts (4) that fix the top half of the bearing housing (5) on the generator (3).
-Remove the bolts (6) at the split line of the bearing housing (2 and 5).
-Use the lifting eyebolts (9) to lift the bearing housing cap(5) so that the cap is uncoupled completely from the bottom half of the stationary baffle (11), labyrinth seals and labyrinth seals carrier (20) and bearing liner (12).
-Pull the bearing housing cap forward out and away from the bearing area. Loosen and remove the bolts (19) securing the upper half of the stationary baffle. Remove the bolts (10) securing the upper half of the labyrinth seal carrier (20).
-Lift the upper half of the bearing liner (13).
-Remove the bolts at the split line of the oil ring (14) and carefully take them apart and remove them.
-Remove the garter springs that encircle the labyrinth seal. Lift off the upper half of each seal. Then rotate the bottom half of each seal out of the grooves in the seal carrier and bearing housing and remove it.
-Disconnect and remove RTD's that enter the bottom half of the bearing liner.
-Using a hoist or jack, raise the shaft slightly so that the bottom half of the bearing liner can be rolled out of the bearing housing.

Important: To make that feasible it is required that bolts 4 and 6 of the other bearing half be loose.

-Carefully roll out the bottom half of the bearing liner and remove it.
-Loosen and remove the bolts (19) securing the bottom half of the stationary baffle (11). Loosen and remove the bolts (10) securing the bottom half of the labyrinth seal carrier (21).
-Remove the bolts (4) securing the bottom half of the bearing housing (2).
-Loosen and remove the bolts (8) securing the machine seal (7).
-Thoroughly clean and inspect all individual; parts which have been removed. Clean the inside of the bearing housing.

-To reassemble the bearing, follow the instructions given above in the reverse sequence.

NOTE: Fastening torque of the bearing fixing bolts to the generator = 10 Kgfm

Non drive end side

-Thoroughly clean the outside of the bearing housing. Loosen and remove the oil drain plug (1) at the bottom of the bearing housing allowing complete drainage of the lubricant.
-Loosen and remove the bolts (19) and remove the bearing external cover (11).
-Loosen and remove the bolts (4) that fix the upper half of the bearing housing (5) on the generator (3). Remove the bolts (6) at the split line of the bearing housing cap (2 and 5).
-Use the lifting eyebolts (9) to lift the bearing housing cap (5) uncoupling it completely from the bottom halves of the bearing housing (2), labyrinth seal and bearing liner (12).
-Loosen and remove the upper half of the bearing liner (13).
-Remove the bolts at the split line of the oil ring (14) and carefully take them apart and remove them.
-Remove the garter spring that encircle the labyrinth seals and remove the upper half of the ring. Then rotate the bottom half of the labyrinth seal and roll it out of the bearing housing and remove it.
-Disconnect and remove RTD's that enter the bottom half of the bearing liner.
-Using a hoist or jack, raise the shaft slightly so that the bottom half of the bearing liner can be rolled out of the bearing housing.
-Carefully roll out the bottom half of the bearing liner (12) and remove it.
-Remove the bolts (4) and remove the bottom half of the bearing housing (2).
-Loosen and remove the bolts (8) and remove the machine seal (7).
-Thoroughly clean and inspect the individual parts. Clean the inside of the bearing housing.
-To assemble the bearing, follow the instructions given above in the reverse sequence.

NOTA: Fastening torque for the bearing fixing bolts to the generator = 10 Kgfm

6.2.6.3. SLEEVE BEARING ASSEMBLY

Check contact face and mounting recess making sure it is clean and properly machined, smooth and free of sharps.
Inspect shaft dimensions to ensure they meet the tolerances specified by Renk and if shaft is smooth enough (< 0.4).
Remove the upper half of the housing (2) and bearing liners (12 and 13). Check for any damage caused during transportation and thoroughly clean the contact surfaces.
Lift the shaft slightly and locate the bottom half of the bearing into the mounting recess of the machine end shield and bolt it into position.
Apply oil to spherical seats in the housing and shaft and place the bottom half of the bearing liner (12) into position. Special care must be taken so that the fitting axial surfaces of the bearings are not damaged. After aligning the split faces of the bottom half of the bearing liner and the housing base lower the shaft into place. With a slight hammer blow against the housing base, fit the liner into its seating so that the liner axis and shaft axis are parallel. This procedure produces a high frequency vibration which reduces the static friction between the liner and the housing and allows a correct alignment of the bearing liner.
The self-alignment capability of the bearing is to compensate only the normal shaft deflection during assembly. The further step is to install the oil ring. Care must be taken when handling the oil ring once a successful bearing operation will depend on the correct lubrication provided by the oil ring. The bolts should be fastened slightly. Any existing edge should be remove carefully in order to ensure a smooth operation of the oil ring. When performing any maintenance service, care must be taken in order not to modify oil ring geometrical shape.
The outside of the two bearing liner halves is stamped with identification numbers or marks near the split line to serve as positioning guide. Place the upper half of the bearing liner aligning its identification marks with the corresponding ones at the bottom half. Incorrect fitting can lead to serious damages to bearing liners.
Check to ensure that the oil ring can still rotate freely on the shaft. With the bottom half of the bearing liner in place, install the seal on the flange side of the housing. (See item 5.5.7).
After coating the split faces with a non-hardening sealing compound, place the upper half of the bearing housing into position (5). Care must be taken that the seal fits properly into the groove. Ensure also that the anti rotating pin be seated without any contact with the corresponding hole in the bearing liner.

- **NOTE:** Bearing housing and bearing liner may be interchangeable as complete assembly only (individual halves are not interchangeable).

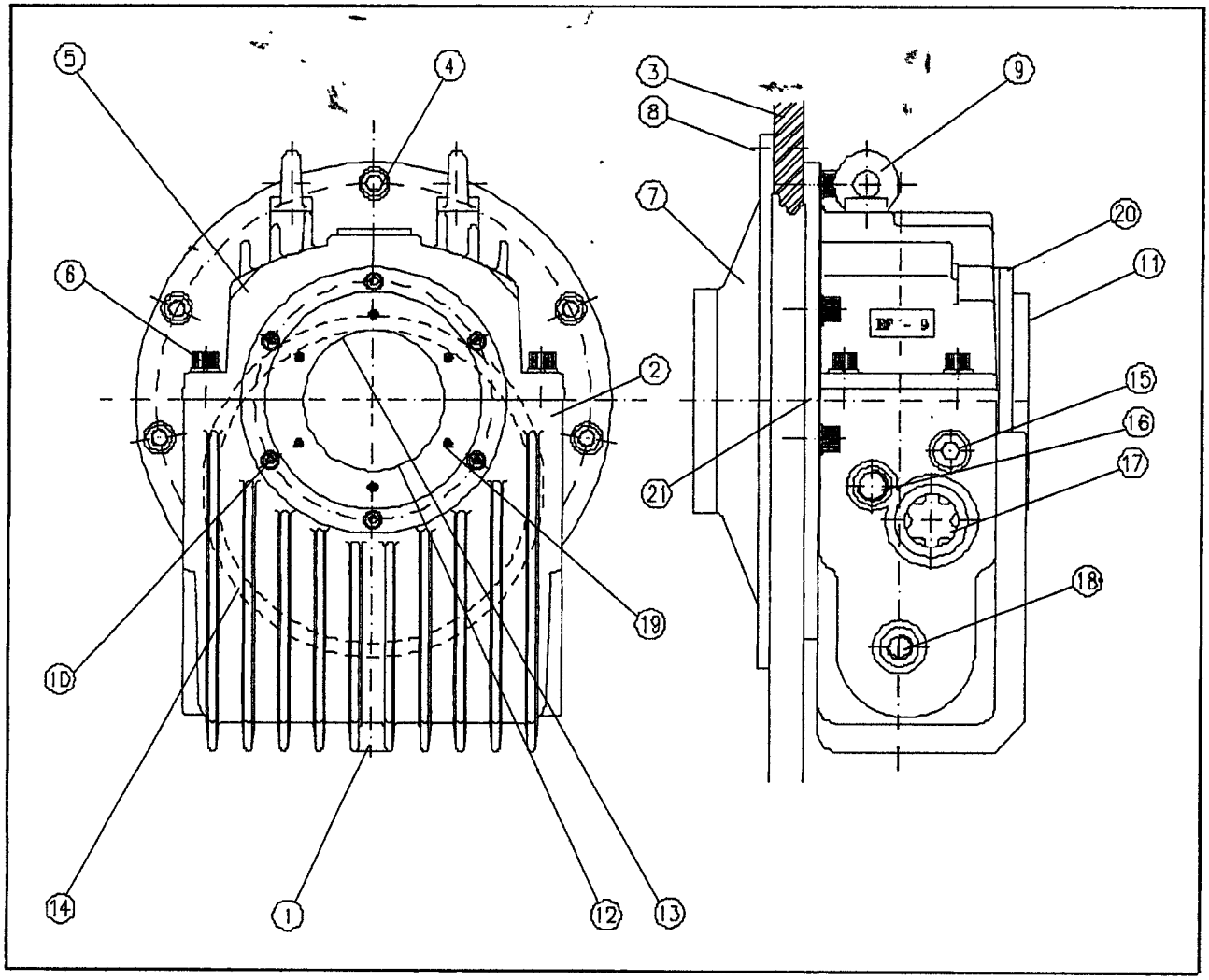
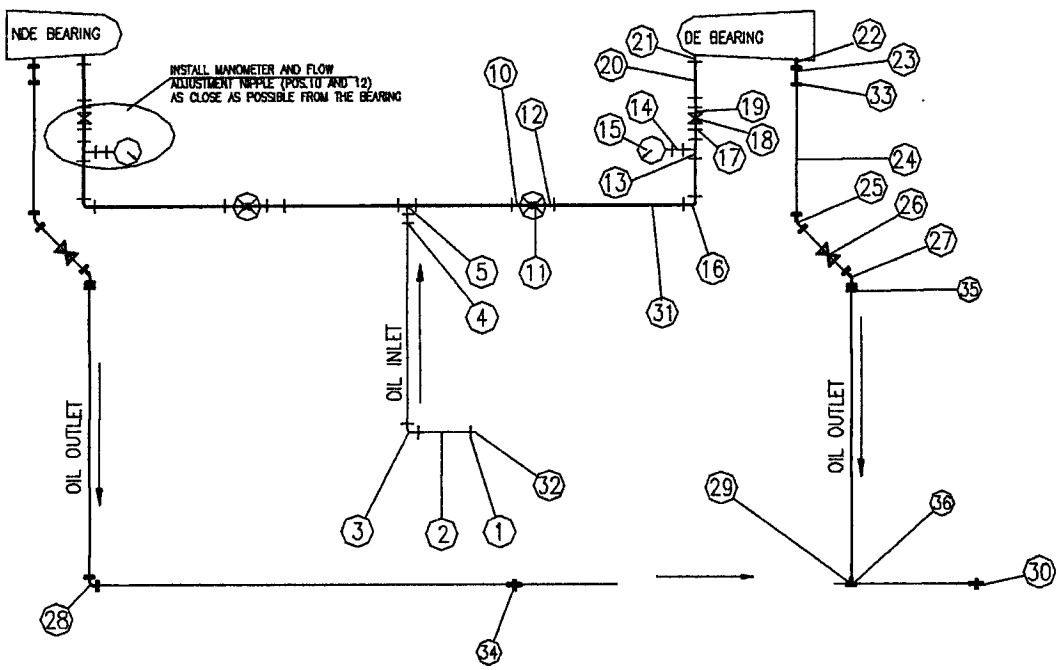


Figure 4.1
1) Drain plug;
2) Bearing housing;
3) Generator frame;
4) Fixing bolts;
5) Bearing housing cap;
6) Bearing housing cap split line bolt;
7) Machine seal;
8) Machine seal bolt;
9) Lifting eyebolt;
10) External cover bolts;
11) External cover
12) Bearing liner – bottom half;
13) Bearing liner – top half;
14) Oil ring;
15) Oil inlet;
16) Connection for temperature sensor;
17) Oil sight glass or oil outlet for lubrication;
18) Drain for pipes;
19) External protection bolts;
20) Labyrinth seal carrier;
21) Labyrinth seal carrier – bottom half

INDEPENDENT LUBRICATION SYSTEM - WEG STANDARD CONFIGURATION

AN INDEPENDENT LUBRICATION SYSTEM FOR SLEEVE BEARINGS


NDE BEARING
INSTALL MANOMETER AND FLOW ADJUSTMENT NIPPLE (POS.10 AND 12) AS CLOSE AS POSSIBLE FROM THE BEARING
DE BEARING
OIL INLET
OIL OUTLET
OIL OUTLET

NOTE:

1. Keep inclination of 2 to 3° between positions 28 and 29.
2. Clean oil inlet and outlet tubes .
3. Use positions 35 as counter nut in positions 25 to 29.

(*) ERMETO CONNECTION SYSTEM

Quantity	Description	Drawing	Position	Material Item	Weight	Material Item	Note
10	Pressure washer	TCG - 10	30			0355.0141	B4
10	Screw bolt	TCG - 24	29			0343.0103	M4x10
10	Clamper	6600.3245	28				
10	Pressure washer	TCG - 10	27			0355.0168	B6
10	Hexangle bolt	TCG - 28	26			0344.1253	M6x15
5	Clamper	9001.4792	25	6701.6259			
02	LH-50 liquid thread sealing		24			0018.1842	Permabond
1	Plug 301, 1 1/2 " diameter		23			0018.1418	TUPY
1	TI30, 1 1/2"diameter		22			0018.1416	TUPY
1	Elbow 90, 1 1/2 " diameter		21			0018.1413	TUPY
4	Hexangle nut 1 1/2"BSP		20			0018.1843	
4	Elbow 45 120, 1 1/2" diameter		19			0018.1411	TUPY
6m	Galvanized steel tube w/o welding, 1 1/2" x 4.25 diameter		18	0018.1410			TUPY
3	Tepered iron connection base 1 1/2"BSP		17			0018.1237	TUPY
2	Male-female adapter MAF 3/8 x 3/4 BSP		16			0018.2613	ERMETO
2	Male connection BSP UMA 25 x 3/4 BSP		15			0014.9121	ERMETO
1m	Steel tube w/o welding TN 25210		14	0014.9071			ERMETO
2	Female connection UFA 25x3/4 NPT		13			0018.0917	ERMETO
2	Flow adjusting nipple NPT 3/4 x NPT 3/8	9002.4982	12				
2	Female connection UFA 10x3/8 NPT		11			0018.3079	ERMETO
2	Manometer (***)		10			0018.0914	WILLY
2	Female-female adapter ffa 3/8 NPT x 1/2 NPT		09			0018.3078	ERMETO
2	TE Male TMA 10x3/8 NPT		08			0018.3077	ERMETO
2	Male connection NPT UMA 10x3/8 NPT		07			0018.3076	ERMETO
2	Flow adjusting valve FN-03-20		06			0018.3075	VICKERS
2	Male connection NPT UMA 10x 3/8 NPT		05			0018.3076	ERMETO
6m	TE orTIA10		04			0018.3064	ERMETO
1	Steel tube w/o welding TN 100070		03	0018.3063			ERMETO
1	Double connection UDA10		02			0018.3062	ERMETO
	Connection plugger OBA 10		01			0018.3061	ERMETO

6.2.6.4. SETTING OF THERMAL PROTECTIONS (100)

Each bearing is fitted with a PT100 temperature detector installed directly in the bearing liner near the point where load is applied. This device must be connected to a controlling panel with the purpose of indicating any overheating and protecting the bearing when operating under high temperature.

IMPORTANT: The following temperatures must be set on the bearing protective system:

ALARM: 90 C
TRIPPING: 100 C

6.2.6.5. WATER COOLING METHODS

On this case, the oil reservoir on the bearing is equipped with cooling coils through which circulates the water.
The circulating water must present at the bearing inlet a temperature lower or equal that of the environment to allow the cooling process..
The water pressure must be 0.1 Bar and the water flow equal to 0.7 l/s. P.h. must be neutral.

NOTE: When connecting the cooling coils, leaks in or on the bearing housing as well as oil reservoir must be avoided to avoid contamination of the lubricating oil.

6.2.6.6. LUBRICATION

The change of oil in the bearings must be done every 8000 operating hours or whenever the lubricating oil changes its lubricating properties. The viscosity and Ph of the oil should be checked periodically.

Oil level must be checked every day and it must be kept at the center of the oil level sight glass.

The bearing must be filled in through the grease fitting available with a prescribed type of oil. All threaded holes not in use should be plugged.

Alsó check all connections for oil leaks.
The correct oil level is that when the lubricant can be seen at the center of the sight glass. Using more quantity of oil will not damage the bearing, however, excessive amount may cause the oil to leak through the shaft seals

IMPORTANT:
The cares taken with bearing lubrication will determine the life time of such bearings as well as safety motor operation. So it is quite important to follow these recommendations:

- The oil selected must have a viscosity suitable for the bearing operating temperature. This must be checked during eventual oil change or during periodical maintenance.
- If the bearing is filled in with oil below the required oil level or if the oil level is not checked periodically, insufficient lubrication may lead to damage of the bearing liner. The minimum oil level is reached when the oil can just be seen in the oil sight glass when the machine is not in operation.

6.2.6.7. SHAFT SEALS

The two halves of the labyrinth seal are held together by a garter spring. They must be inserted into the groove of the carrier ring in such a way the stop pin is always in the corresponding recess in the upper half of the housing. Incorrect installation destroys the seals.
The seals are to be carefully cleaned and coated with a non-hardening sealing compound on the faces in contact with the grooves. The drain holes in the lower part of the seal must be cleaned and unobstructed. When installing the bottom half of the seal, press it lightly against the underside of the shaft.
An additional sealing is provided inside the generator to prevent sucking of oil due to by low pressure caused by the generator cooling system.

6.2.6.8. OPERATION

The operation of generators fitted with sleeve bearings is similar to those fitted with ball or roller bearings.
It is recommended that the oil circulating system be accompanied carefully as well as the first operating hours.
Before making the start up, check the following

- If the oil used has been prescribed accordingly.
- The characteristics of the lubricating oil.
- Oil level.

- Alarm and tripping temperature set up for the bearings (respectively 100 and 120 C for alarm and tripping).

During first start up, check for vibrations or noises. In case bearing operation is noisy and uneven, generator must be switched off immediately.

The generator must operate for several hours until the bearing temperature is fixed within the limits indicated previously. If a temperature overheating occurs, generator must be stopped immediately and then check the bearings and temperature detectors.

When bearing operating temperature is reached, check for any oil leakage on the plugs, joints or shaft end.

6.3. AIR GAP CHECKING (LARGE ODP GENERATORS)

After disassembling and assembling the generators, air gap must be measured between stator and rotor surfaces to check the concentricity. The air gap variation at any two vertically opposite points must be less than 10% of the average air gap measurement.

6.3.1. DRYING OF THE WINDING

It is recommended that this task be undertaken carefully and by qualified personnel.

The rate of temperature rise should not exceed 5 C per hour and the final temperature should not exceed 150 C.

Either excessive temperature or a too quick temperature rise can generate vapor which damages the winding insulation.

NOTE: From here on, the following abbreviations will be used:

AND – anode in the frame;
CTD – cathode in the frame

During the drying process, the temperature should be monitored carefully and the insulation resistance should be measured at regular intervals. In the initial stage, the insulation resistance will decrease due to temperature increase, but it will increase as the insulation gets dry.

The drying process should continue until successive measurements of the insulation resistance indicate a constant insulation resistance which should be higher than the minimum value specified.

The winding is effectively dried through a warm air flow.

To ensure dry air, a certain number of fans must be installed uniformly at the air inlet.

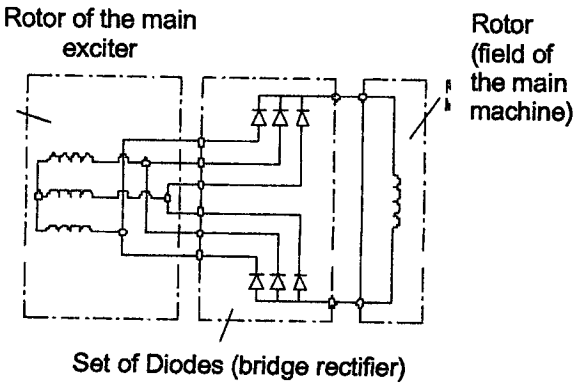
In case the humidity content is excessively high, space heaters should be provided between fans and windings, or use forced ventilation heaters.

Is it important to provide an efficient ventilation inside the generator during the drying process allowing actual removal of the humidity.

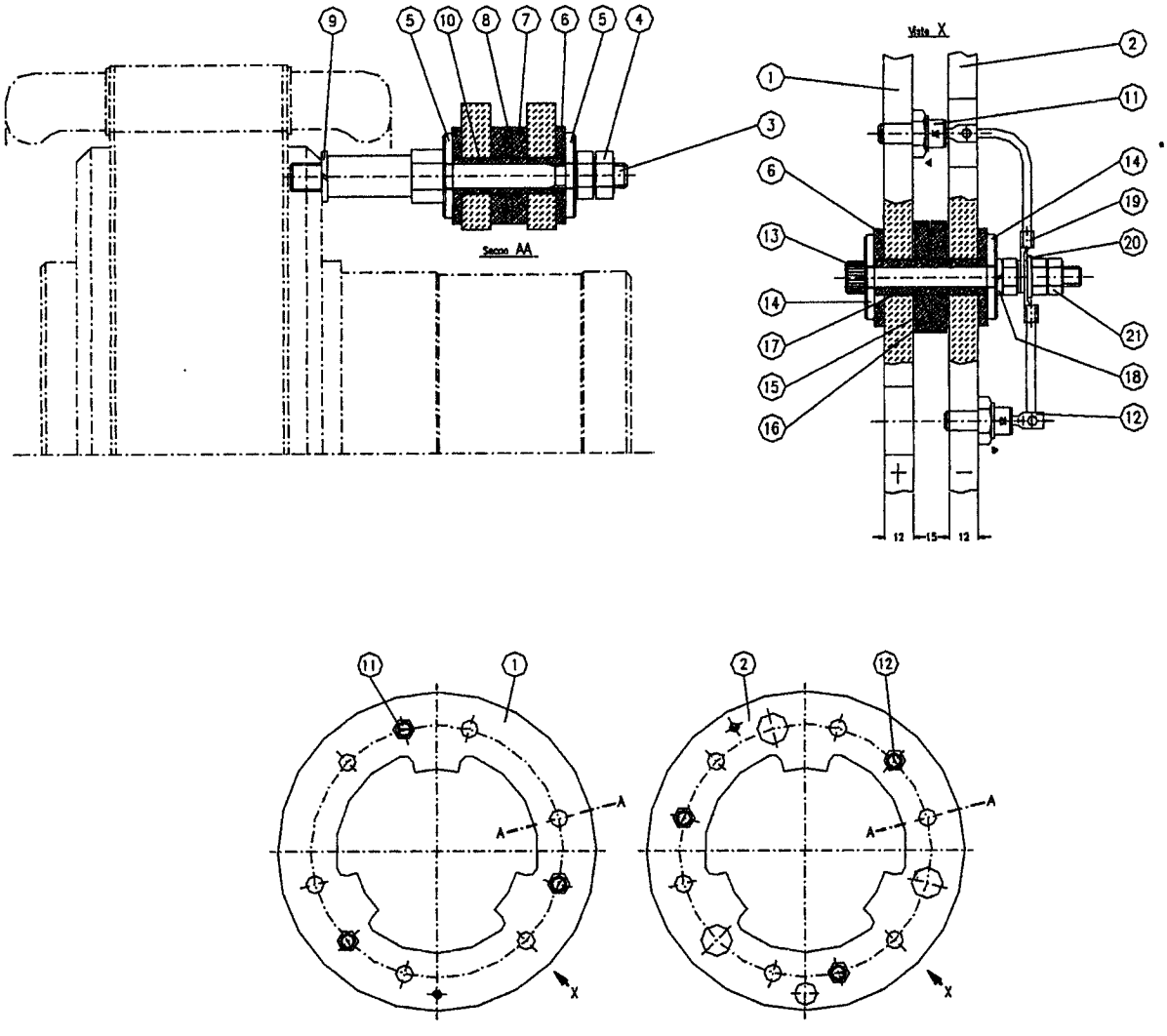
The dehumidifying heat can also be obtained from energizing the generator space heaters or circulating current through the winding to be dehumidified

7. REPLACEMENT OF ROTATING DIODES

When a damage occurs on one of the rotating diodes, it is also required to check the conduction characteristics of the remaining diodes. The set of diodes makes part of the field excitation circuit of the synchronous machine. Electrically, this circuit presents the following configuration



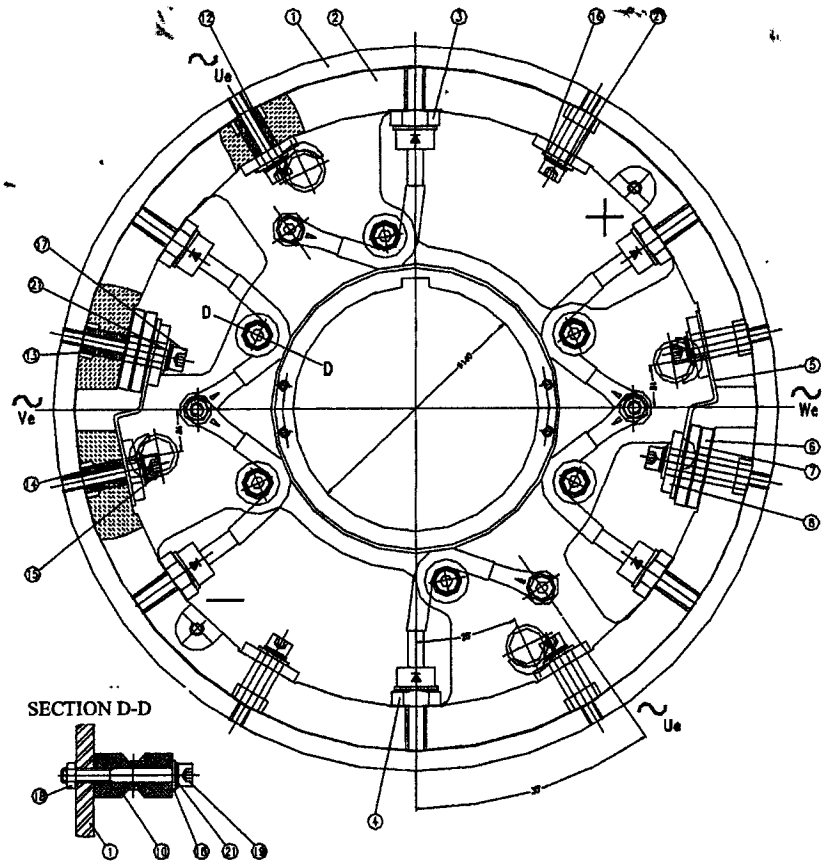
SET OF DIODES

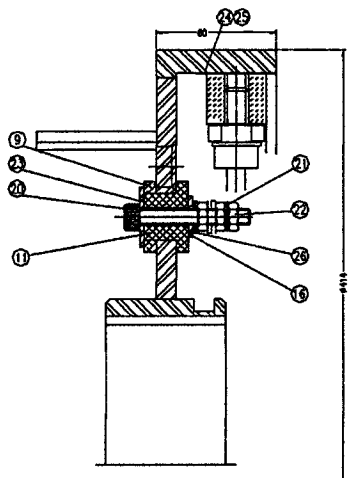


SET OF DIODES

Quantity	Description	Position
9	Hexagonal nut	21
3	Flat washer	20
9	Eyebolt with cylindrical sleeve	19
3	Pressure washer	18
3	Isolating bushing	17
4	Varistor C12	16
6	Lead washer	15
6	Flat washer	14
3	Cylindrical bolt with hexagonal internal shape	13
3	Diode DS8 Cathode (-)	12
3	Diode DS8 Anode (+)	11
3	Isolating bushing	10
3	Pressure washer	09
4	Isolating washer	08
8	Isolating washer	07
8	Isolating washer	06
6	Flat washer	05
6	Hexagonal nut	04
	Supporting bolt	03
3	Support for diodes	02
1	Support for diodes	01

SET OF DIODES



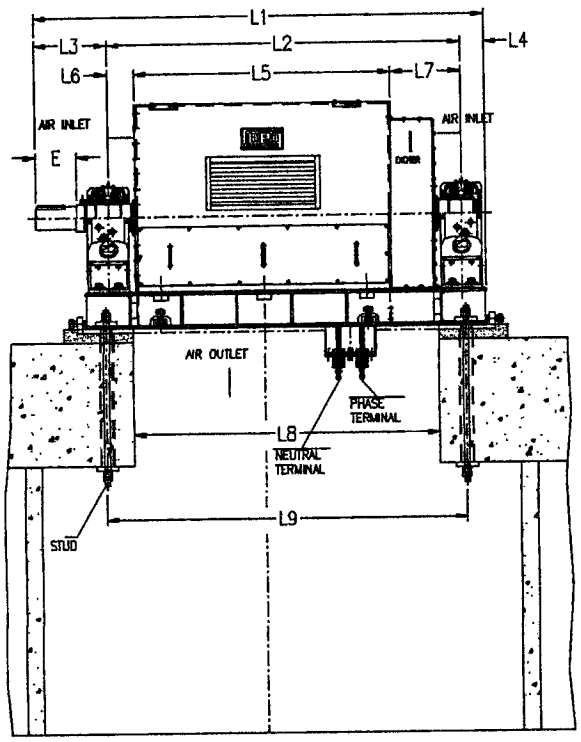


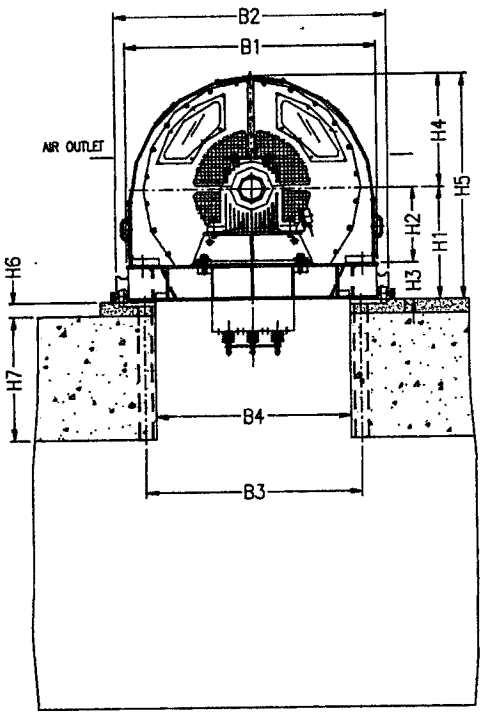
SET OF DIODES

Quantity	Description	Position
8	Silver spring SCREW CENTER 680.008	26
1	Polyester film	25
1	Electric insulating film	24
4	Flat washer D12xD30	23
12	Brass nut M8	22
18	Toothed washer - Form A D8.2XD14	21
4	Cylindrical bolt with hexagonal internal shape M8x55	20
6	Cylindrical bolt with hexagonal internal shape M8x65	19
6	Hexagonal nut M8x1.25	18
2	Cylindrical bolt with hexagonal internal shape M8x60	17
18	Flat washer D20xD8.5x2	16
6	Cylindrical bolt with hexagonal internal shape M8x45	15
2	Isolating bushing D15xD8.1x33	14
2	Isolating bushing D15xD8.1x48	13
4	Isolating bushing D15xD8.1x.31	12
4	Isolating bushing with shoulder	11
6	Isolating bushing	10
4	Isolating washer D30xD23x6	9
8	Isolating washer D35xD15.1x6	8
6	Lead washer	7
4	Varistor C12	6
2	Connection bridge for diodes	5
3	Diodes DS10 CATHODE (-)	4
3	Diodes DS10 ANODE (+)	3
1	Split ring for diodes	2
1	Support for diodes	1

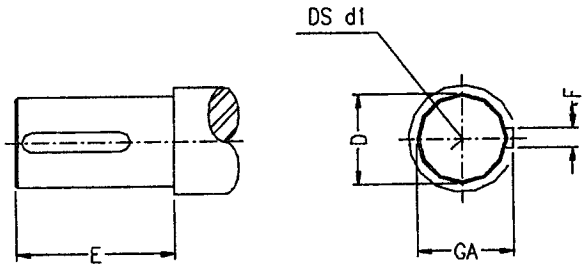
SSA TYPE

Mounting	D5
Degree of Protection	IP 23
Bearing type	Sleeve
Cooling method	IC 01



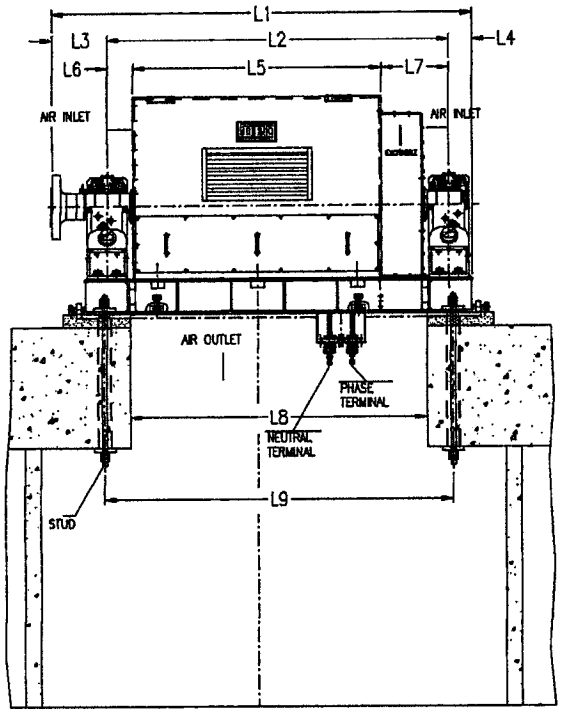


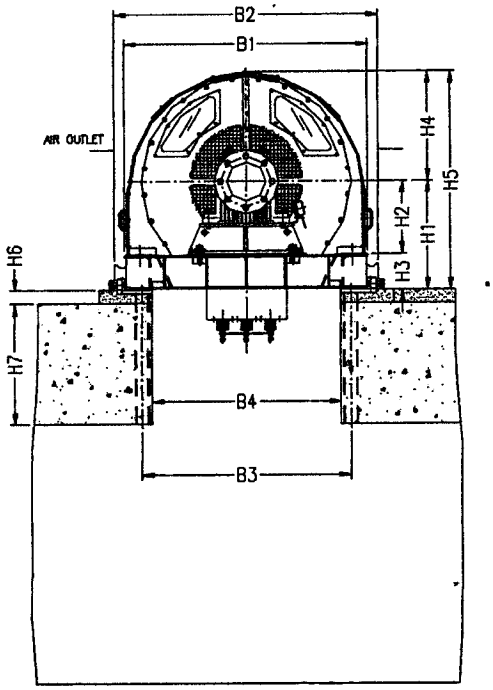
SHAFT END DETAIL



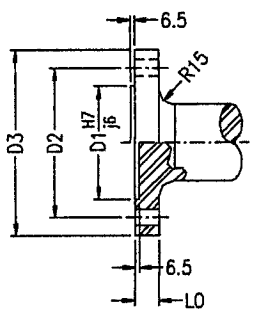
SSA TYPE

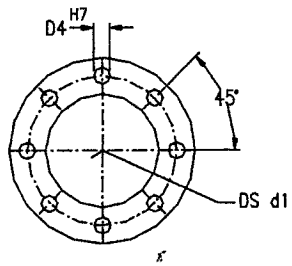
Mounting	D6
Degree of Protection	IP 23
Bearing type	Sleeve
Cooling method	IC 01





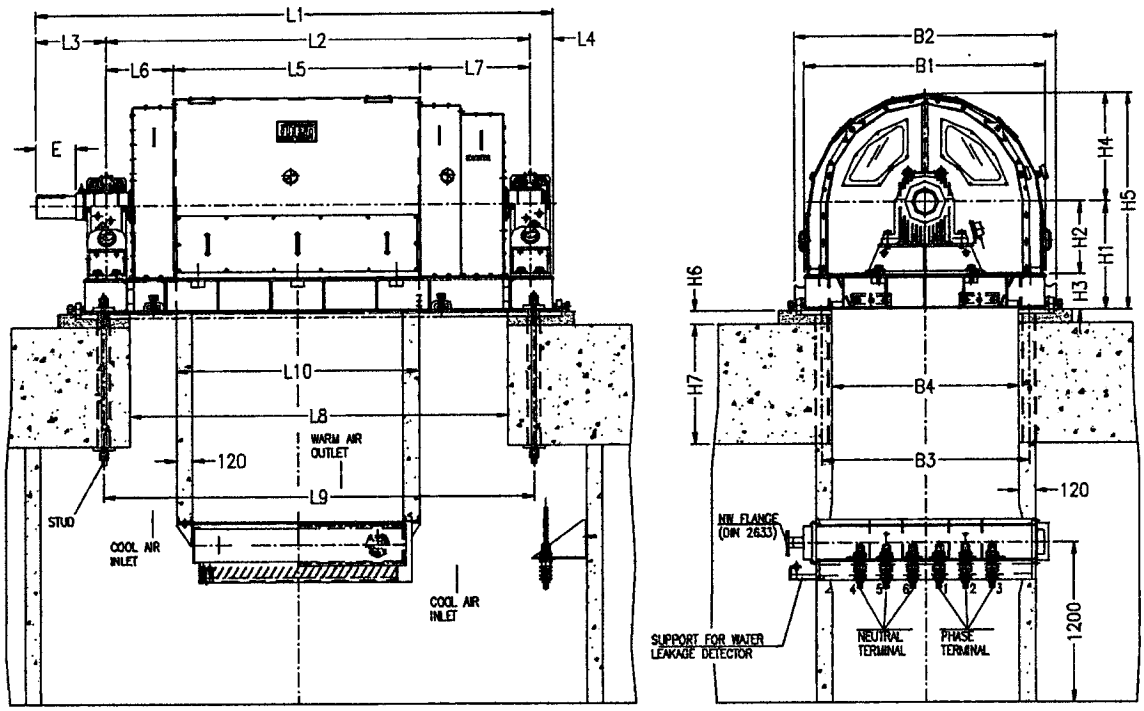
SHAFT END DETAIL



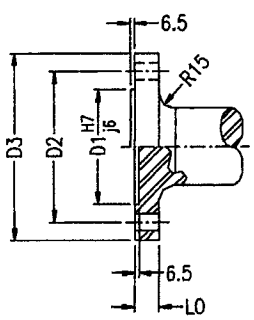


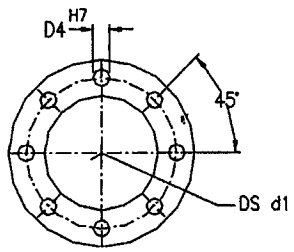
SSW TYPE

Mounting	D5
Degree of Protection	IP54/55
Bearing type	Sleeve
Cooling method	IC 81W7



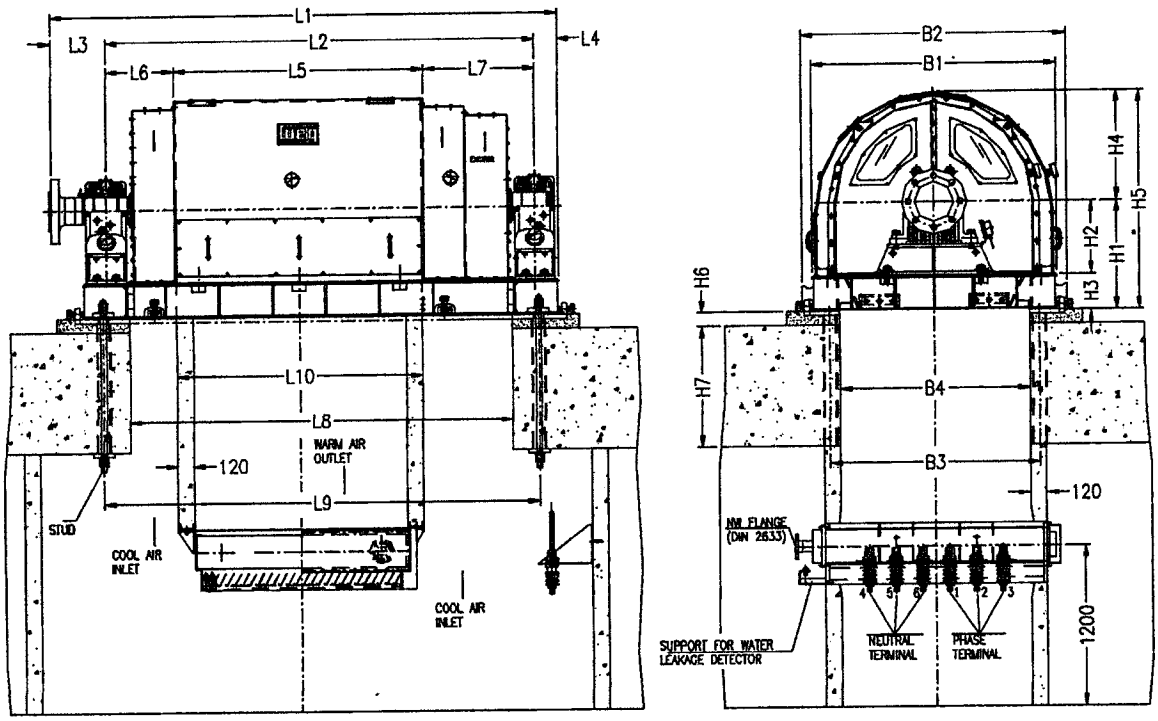
SHAFT END DETAIL



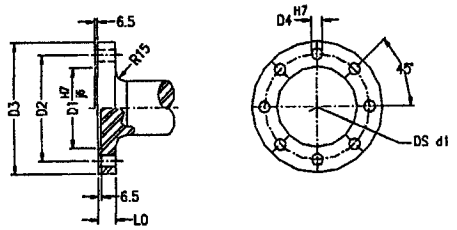


SSW TYPE

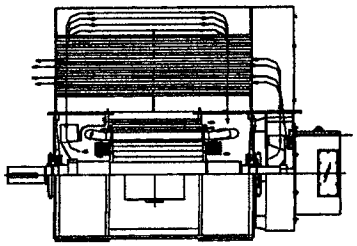
Mounting	D6
Degree of Protection	IP54/55
Bearing type	Sleeve
Cooling method	IC 81W7



SHAFT END DETAIL

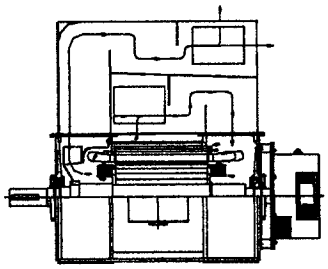


AXIAL COOLING METHOD – FRAMES 355 TO 500 (WITHOUT RADIAL CHANNELS)



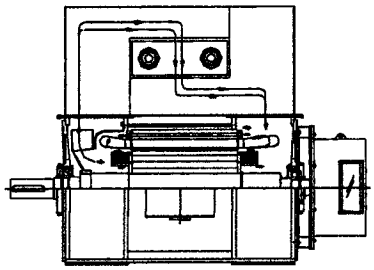
AIR-AIR HEAT EXCHANGER

The machine can have degree of protection IP44 IP54, IP55 or equiva IP44, IP54 or equivalent.. Two fans, one internally and another externally are coupled to the shaft.
The heat exchanger is mounted on top of the machine



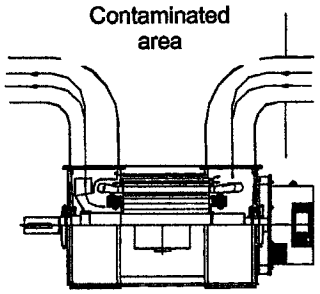
DRIP PROOF (SELF-VENTILATED)

On this method, machine can have degree of protection IP23, IP24 or equivalent, identifying a drip proof machine.
An internal fan is coupled to the shaft which draws the coolant and blows it through the machine and then discharged to the surrounding medium



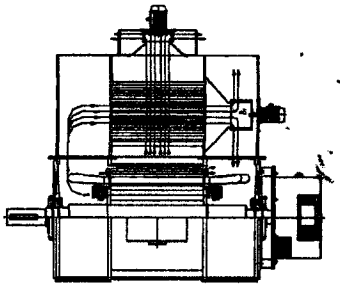
AIR WATER HEAT EXCHANGER

Machine with air-water heat exchanger can have degree of protection IP44, IP54, IP%% or equivalent. A fan is coupled to the machine shaft



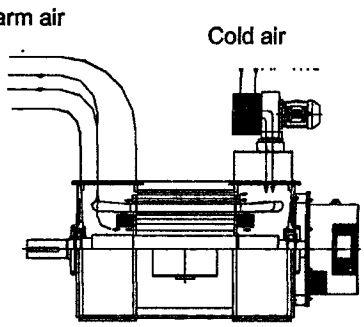
SELF VENTILATED BY DUCTS (SSD, SMD)

On this method, an internal fan is coupled to the machine shaft which draws the coolant from a remote medium, passes through the machine and is then discharged to a surrounding medium.



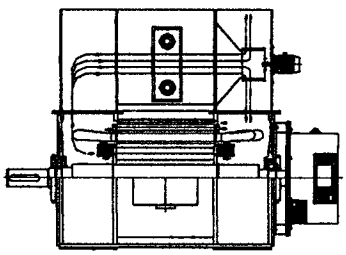
INDEPENDENT COOLING WITH AIR-AIR HEAT EXCHANGER (SSI, SMI)

On this method there is an independent fan that circulates the coolant internally. The other independent fan draws the coolant from a surrounding medium and circulates it through the air-air heat exchanger..



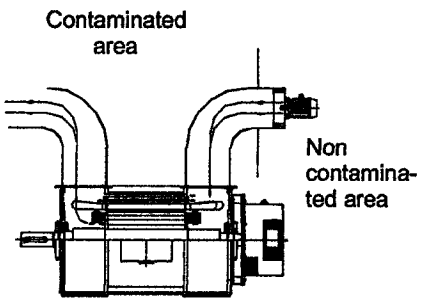
INDEPENDENT COOLING, DRIP PROOF GENERATOR

The coolant is circulated through the machine by an independent fan which is mounted on top of the machine. The coolant is then discharged to a surrounding medium.



INDEPENDENT COOLING WITH AIR-WATER HEAT EXCHANGER (SSL, SML)

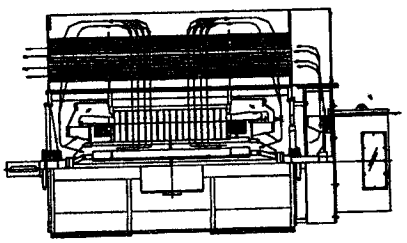
On this method, an independent fan circulates the coolant internally via an air-water heat exchanger



SEPARATE COOLING BY DUCTS (SST, SMT)

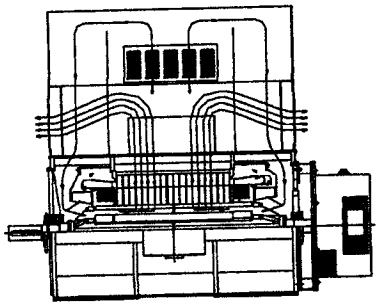
The coolant is drawn from a remote medium and is circulated through the machine by a separate fan and is then discharged to a surrounding medium

SYMETRIC BILATERAL COOLING – FRAMES 560 TO 1000 (WITH RADIAL CHANNELS)



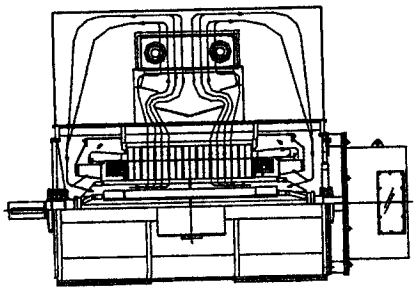
AIR-AIR HEAT EXCHANGER

The machine can have degree of protection IP44, IP54, IP55 or equivalent.
Two fans, one internally and another externally are coupled to the machine shaft.
The heat exchanger is mounted on top of the machine.



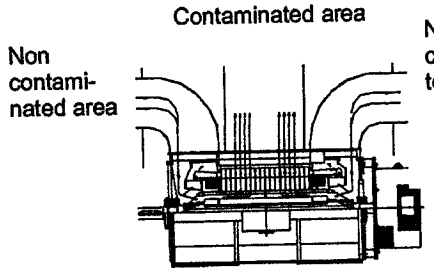
DRIP PROOF (SELF-VENTILATED (SSA, SMA)

On this method, machine can have degree of protectIP23, IP24 or equivalent, identifying a drip proof machine.
Two internal fans are coupled to the machine which draw the coolant from a surrounding medium, passes through the it and is then discharged to a surrounding medium



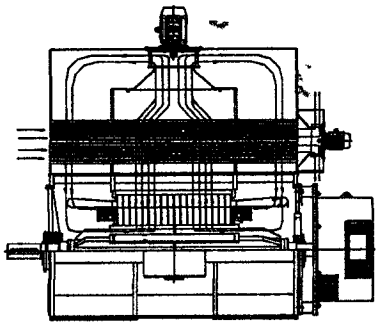
AIR-WATER HEAT EXCHANGER (SSW, SMW)

An air-water heat exchanger machine can have degree of protection IP44, IP54, IP55 or equivalent. Two cooling fans are coupled to the machine shaft.



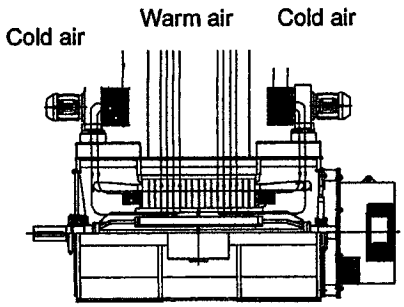
SELF-VENTILATED BY DUCTS (SSD, SMD)

On this method, two fans are coupled to the machine shaft which draw the coolant from a remote medium, passes through the machine and is then discharged to a surrounding medium.



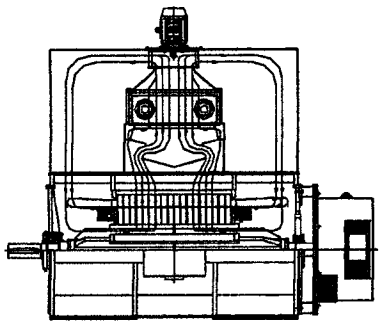
INDEPENDENT COOLING WITH AIR-AIR HEAT EXCHANGER (SSI, SMI)

On this method, an independent fan circulates the coolant internally. The other independent fan draws the coolant from a surrounding medium and makes it circulate via an air-air heat exchange



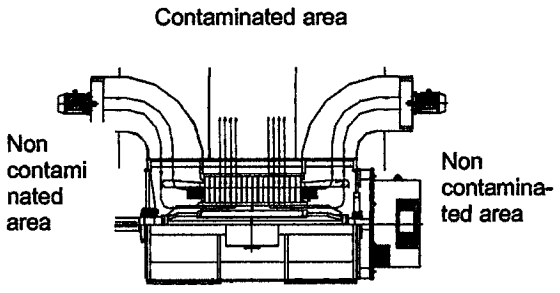
INDEPENDENT COOLING, DRIP PROOF GENERATOR (SSV, SMW)

The coolant is circulated through the machine by two independent fans which are mounted on top of it. The coolant is then discharged to a surrounding medium.



INDEPENDENT COOLING WITH AIR-WATER HEAT EXCHANGER (SSL, SML)

On this method, an independent fan circulates the coolant through the machine internally via an air-water heat exchanger.



SEPARATE COOLING BY DUCTS (SST, SMT)

The coolant is drawn from a remote medium by two separate fans and guided by ducts to the machine. The coolant is then discharged to a surrounding medium.

8. ABNORMAL SITUATIONS DURING OPERATION

We are listing below some abnormal situations that can occur during generator operation along with suggested corrective measures.

- The generator does not excite

ABNORMAL SITUATION	CORRECTIVE MEASURE
- Excitation switch, if any, is not operating. - Interruption in the auxiliary winding circuit.	- Check the switch. - Check lead connection of the auxiliary exciter at the connection block proceeding up to the regulator connection block.
- Residual voltage excessively low.	- Provide an external excitation with a 12 to 20Vdc battery until the excitation starts: Negative pole at K; Always disconnect regulator leads to prevent from any damage; Positive pole at I. Warning: When using a battery, this can not be grounded.
- Driving speed is not correct.	- Measure the speeds; eventually make new adjustment.
- Interruption in the main excitation circuit.	- Measure all rotating diodes; replace all defective diodes or even the complete set.
- Defective relay or other regulator component.	- Replace voltage regulator.
- External voltage adjusting potentiometer broken or connection interrupted.	- Check connection of the terminals as well as the potentiometer.
- Protection varistor.	- If defective, replace it; if replacement parts are not available, remove it temporarily.

- **Generator does not excite up to rated voltage**

ABNORMAL SITUATION	CORRECTIVE MEASURE
- Defective rotating rectifiers.	- Measure individually all rotating diodes; replace the defective diodes; eventually replace the complete set.
- Incorrect speed.	- Measure the speed and adjust it.
- Adjustment below the rated one	- Adjust the potentiometer
- Feeding voltage of the regulator is not in accordance with outlet voltage required.	- Check if connections are in accordance with Voltage Regulator Manual.

- **At no load, generator excites up to rated voltage, however it collapses when load is hooked up**

ABNORMAL SITUATION	CORRECTIVE MEASURE
- Defective rotating diodes.	- Measure individually all rotating diodes; replace the defective diodes; eventually replace the complete set.
- Significant voltage drop.	- Control selector of the drive machine

- **At no load, generator excites by over-voltage**

ABNORMAL SITUATION	CORRECTIVE MEASURE
- Defective power tiristor . - Defective regulator feeding transformer.	- Replace regulator.
- Regulator feeding voltage is not in accordance with outlet voltage required.	- Remake the connections. Check the Voltage Regulator Manual.

- **Variations on the generator voltage**

ABNORMAL SITUATION	CORRECTIVE MEASURE
- Stability incorrectly adjusted	- Adjust regulator stability
- Speed variations on the drive machine	- Frequent variations are originated from the drive machine and these must be eliminated

IMPORTANT:

The machines included in this Manual are constantly updated. For this reason, any information given herewith may change without prior notice.

WARRANTY TERMS FOR ENGINEERING PRODUCTS

Weg Maquinas Ltda warrants its products against defects in workmanship and materials for a period of twelve (12) months from invoice date made by representative or distributor or eighteen (18) months from manufacturing date, whichever occurs first.
The warranty condition is not connected with start up date of the equipment and the following requirements must be accomplished:

- Adequate transportation, handling and storage;
- Correct installation along with specified environment conditions and free of aggressive particles;
- Operation within normal running conditions;
- Proof of periodical preventive maintenance activities;
- Repairs and/or replacements made only by qualified personnel duly authorized in writing by Weg Maquinas;
- In case of any abnormal situation, that the equipment be available to the supplier for a period of time long enough to identify the cause of the failure and the required repair services;
- Immediate notice by buyer about the defects occurred and that these are further acknowledged by Weg Maquinas as manufacturing defects.

This warranty does not include disassembly services at buyers facilities, transportation cost for the equipment, neither transportation, accommodation or meals for Weg technicians when these are requested by buyer; Any service required will only be performed at a repair shop duly authorized by Weg Maquinas or at its facilities.

Any component under normal use having useful life time shorter than the warranty period is not included in this warranty.

The repair and/or replacement of parts or equipment, at Weg Maquinas own decision within the warranty period will not extend the original warranty period.

The present warranty is limited to the equipment supplied herewith and Weg Maquinas will have no obligation or liability for personnel injury, damages to third parties, other equipment or installations loss of profits or any other emergent or consequential damages.

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